Neris Case Study Report (Deliverable D31)

Subtitle Report

Author	Rasa Ščeponavičiūtė and Daiva Semėnienė
Date	Date

Contact information AquaMoney Partners

Institute for Environmental Studies (IVM),
Vrije Universiteit Amsterdam
De Boelelaan 1087, 1081 HV Amsterdam
THE NETHERLANDS

Institute for International and European Environmental Policy (Ecologic)
Pfalzburger Strasse 43/44, D - 10717 Berlin
GERMANY

Department of Systems Ecology and Sustainability
University of Bucharest (UNIBUC)
Spl. Independentei 91-95,
Postal Code: 050095 Sector 5, Bucharest
ROMANIA

Norwegian University of Life Sciences (UMB)
Department of Economics and Resource Management
P.O. Box 5003, N-1432 Aas
NORWAY

Institute for Water and Environmental Engineering,
Universidad Politecnica de Valencia (UPVLC)
Camino de Vera s/n, 46022 - Valencia
SPAIN

Bureau de Recherches Géologiques et Minières (BRGM)
Direction de la Recherche
3, Av. Claude-Guillemin
BP 36009 45060 Orléans, cedex 2
FRANCE

University of the Aegean (AEGEAN)
Faculty of Environment
University Hill 81 100 Mytilini
GREECE

Research Institute for Soil Science and Agricultural Chemistry (RISSAC),
Hungarian Academy of Sciences
Herman O. street 15. 1022 Budapest
HUNGARY

School of Environmental Sciences
University of East Anglia (UEA)
Norwich NR4 7TJ
UNITED KINGDOM

Center for Environmental Policy (AAPC)
A. Juozapaviciaus 6/2, Vilnius LT-09310
LITHUANIA

Flemish Institute for Technological Research (VITO)
Boeretang 200, B-2400 Mol
BELGIUM

Department of Agricultural Economics and Engineering (DEIAGRA)
Faculty of Agriculture
University of Bologna,
Viale Fanin, 50, 40127 Bologna
ITALY

Norwegian Institute for Water Research (NIVA)
Brekkeveien 19, 0411 Oslo
NORWAY

Royal Veterinary and Agricultural University (RVAU)
Food and Resource Economics Institute
Rolighedsvej 25, 1958 Frederiksberg C
DENMARK

Institute for Advanced Studies Carinthia (IHSK)
Domgasse 3, 9020 Klagenfurt
AUSTRIA

Corvinus University of Budapest (CUB)
Fovám tér 8., 1093 Budapest
HUNGARY

European Commission
DG Research
Unit I.2 - 'Environmental Technologies and Pollution Prevention'

Colophone

SIXTH FRAMEWORK PROGRAMME

This report is a part of the EU funded project AquaMoney, Development and Testing of Practical Guidelines for the Assessment of Environmental and Resource Costs and Benefits in the WFD, Contract n° SSPI-022723.

General				
Deliverable	D31			
Deadline				
Complete reference				
Status	Author(s)	Date	Comments	Date
Approved / Released				
Reviewed by				
Pending for Review				
Second draft				
First draft for Comments				
Under Preparation				
Confidentiality				
Public				
Restricted to other programme participants (including the Commission Service)				
Restricted to a group specified by the consortium (including the Advisory Board)				
Confidential, only for members of the consortium				
Accessibility				
Workspace				
Internet				
Paper				

Contents

Summary

The transboundary Neris river basin, a sub-basin of the Nemunas River Basin District, is situated in the Eastern part of Lithuania. The hydrological system in the Neris river basin is comprised of longer and smaller tributaries; the density of hydrographical network is high, as the number of lakes and rivers in the basin is quite large.

There is one National Park and three regional parks in the Neris River sub-basin, as well as many smaller protected areas. Important from the point of view of water hydrology are seven hydrographical reserves established in the Neris river basin, aimed at preserving distinctive stretches of rivers with typical hydrographical-landscape elements (rifts, meanders, islands, etc.).

The main water users in the Neris river sub-basin are households, industries and fisheries. Water needs in agriculture are not very high, since Lithuania is in a zone of surplus humidity where precipitation levels are quite high. Moreover, the agricultural sector is not widely developed in this area, with farming land occupying about 134,000 hectares. Water use for recreation is gaining increased importance in general in Lithuania; in the Neris sub-basin it has a very high potential due to a variety of landscapes and attractive water sites.

Average data from 2004-2005 show that annual water consumption in the Neris river slightly exceeds 60 million m^3, of which 54 pct (~34 mln m^3) comes from groundwater. As in the whole country, only groundwater is used for drinking purposes in the case study area.

Currently, the population of the Neris river basin is about 700,000 inhabitants, of which 76% live in the capital Vilnius, and about 16% reside in 17 towns with more than 2,000 inhabitants. The rate of water consumption in the household sector in the Neris River sub-basin in 2004-2005 was about 47% of total water consumption. Currently, water consumption per capita in this sub-basin amounts to about 80 litres of water per person per day. It is expected that the water consumption by the household sector in the Neris sub-basin will grow and may reach 145 litres by 2020, though the change in population numbers will be negative. Industrial entities use both groundwater and surface waters for their needs; water consumption in the sector reaches 25% of all water consumed, of which groundwater comprises 23%. Currently, there are 43 IPPC sites in the sub-basin, and this number is expected to increase until 2015; therefore, the industry sector will remain a significant driver for pressures in the Neris sub-basin.

Agriculture is the main source for pollution by BOD7 and NO3, while point sources generate more pollution by NH4 and total phosphorus. Urban wastewater discharges and transboundary pollution are the main sources of pollution by dangerous substances. Agricultural pollution is the main source of shallow groundwater pollution by nitrates. In many regions of Lithuania, shallow groundwater is polluted by high concentrations of nitrates and this causes a risk for deeper layers of groundwater.

Four thresholds (concentrations of BOD7, ammonia, nitrates and total phosphorus) for the identification of water bodies at risk (WBR) in the Nemunas RDB with regard to water quality elements were identified. So far two types of water bodies at risk - due to pollution by BOD and phosphorus - have been designated: there are fourteen water bodies at risk in the Neris sub-basin.

The Neris River Basin's aquatic system provides direct consumptive goods and services from both groundwater and surface water. Water as a consumptive good used for residential needs, food production industry and livestock watering comes from groundwater, while water for agricultural irrigation and manufacturing processes comes from both groundwater and surface waters. Water as a non-consumptive good is used for hydropower production and navigation (transportation of goods and people), however, these uses are not widespread in the Neris basin. Such goods as recreational swimming, boating and angling are widely used and have a big potential for increased use.

Water quality in a number of rivers of the Neris River Basin currently does not meet requirements for the good water status. Measures will be taken to improve the water status and to meet the requirements of the Water Framework

Directive. Environmental benefits (total economic value) of the water system improvement will be assessed in this case study.

The contingent valuation method (face-to-face survey) will be used for the estimation of environmental benefits in the Neris River Basin. Non-use values are expected to be an important part of the total economic value in the Neris river case, where water quality improvement will allow for an improvement of biodiversity. In addition, the case study, recently carried out in the Nevėžis river basin, has revealed that people value the possibility to preserve and maintain water resources for future generations. The likelihood of similar attitudes existing in the current case study area should not be rejected.

The Neris River Basin is a sub-basin of the Nemunas River Basin District and the valuation study will be carried out at the level of the sub-basin. In addition to scale-related questions, three more methodological issues can be tested during the valuation of environmental costs/benefits in the Neris river basin. These include the sensitivity to scope, substitution and benefit transfer methodological issues.

1. Introduction

The main objective of WP4 is to test the guidelines and the methods and procedures to be developed for assessing the WFD resource and environmental costs and benefits of water services across ten representative European river basins. The international river basins of the Scheldt, the Rhine and the Danube have been included to explicitly test this international dimension and its relevance for the practical assessment of environmental and resource costs and benefits. Furthermore, 7 other European basins have been included in order to further test and investigate the robustness of the developed guidelines by including sufficient geographical, economic, political-institutional, and cultural variability and diversity. The case studies furthermore differ in terms of available data and information. The final outcome of WP4 is practical guidelines, which have been tested in practice under a variety of circumstances, which are considered representative and relevant for the implementation of the WFD.

The Status Reports, together with the Blueprint and the Draft Guidelines developed in WP3, will provide the starting point for planning work in the pilot case studies, following the different steps outlined in WP4.

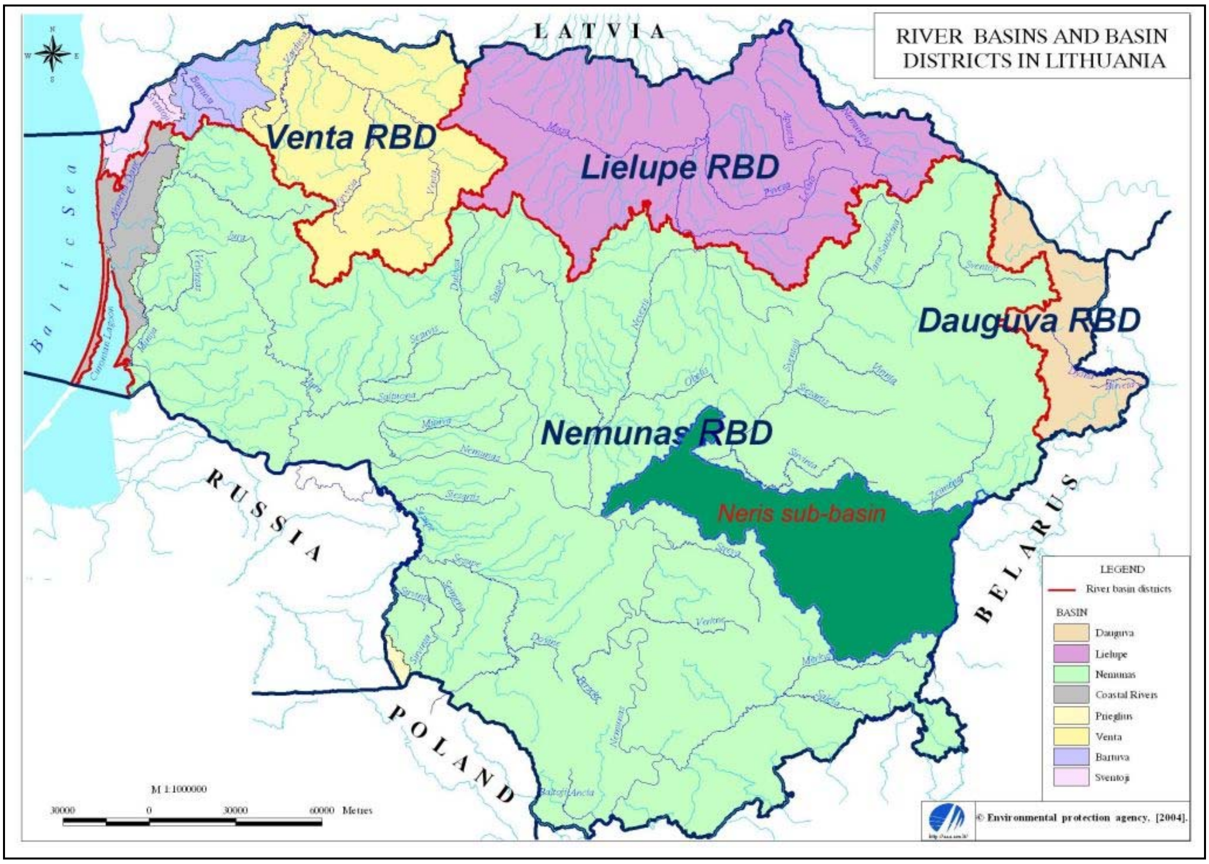
The Status Report at hand provides starting information for the Neris river sub-basin, which is a part of Nemunas river basin district in Lithuania.

2. GENERAL CASE STUDY CHARACTERISTICS

2.1 Location of the case study area (including GIS map)

The transboundary Neris river basin, a sub-basin of the Nemunas River Basin District (hereafter RBD), is situated in the Eastern part of Lithuania. A part of the basin lies in the territories of Belarus and Latvia. In the north, the Neris River Basin borders with the Žeimena, the Šventoji and the Nevėžis sub-basins, and in the south with the Merkys and the Nemunas small tributaries sub-basins.

Figure 1. Location of the Neris River Basin



The source of this transboundary river is situated in Belarus and the upper part of the Neris (called the Vilija in this neighbouring country) of the 234.5 km length flows via the territory of Belarus. The catchment area in Belarus amounts to 11,004.6 km^2. A 6.5-km section of the river coincides with the Lithuanian-Belarusian border, with the remaining part or 228 km flowing in Lithuania. The largest part of the river basin or 13,849.6 km^2 is situated in Lithuania, with only a small part of about 88.1 km^2 found in the Latvian territory. [1] The Neris River basin is asymmetric – 70% of the catchment's total area lies on its right side of the river, where most of the lakes of the basin are situated.[2]

[1] Gailiušis, B. Jablonskis, J. Kovalenkovienė M., Rivers of Lithuania.Hydrografy and flow(lit) (2001) Lithuanian Energy Institute. Monography

[2] Kilkus, k. (1998) Lietuvos vandenų geografija. Vilnius

2.2 Geographical characteristics

The climate in the Nemunas RBD, where the Neris sub-basin is situated, is transitional between maritime and continental. The mean annual temperatures range from -6.7^{0}C in January to 16.8^{0}C in July. Lithuania is in a zone of surplus humidity and its water resources are quite large. Average precipitation varies from 600 to 700 mm, with higher precipitation levels in the Neris basin (from 650 to 800 mm per year). Rainfall contains about 75% of precipitation; evaporation contains 65%, and surface runoff has about 32%.[3]

The upper river flows among wide water-meadows; the slope of the bed here is 0.02 – 0.03%. Below the tributary Narutis (about 143 km from the source), the slope increases, the river banks become dry and sandy, after crossing the border and before the tributary Žeimena the Neris flows through a limno-glacial basin, and after the junction with the Žeimena it runs through moraine formations. The middle part of the river drains fluvio-glacial plains of the Žeimena and the Vilnia. In general, permeable grounds dominate in the Neris river catchment (Kilkus, 1998). The Neris river water feeding system is mixed, about 30-40% comes from melting snow, some 25% from rainfall, and about 35% from groundwater.

High water flow in Lithuania is characteristic to only two rivers in Lithuania – the Nemunas and the Neris. Currently, water levels are measured in three hydrological stations: Buivydžiai (upper river), Vilnius (middle river) and Jonava (lower river). Average runoff of the Neris river is 178 m^3/s; it ranges from 68 m^3/s at the border, 109 m^3/s in Vilnius and 180 m^3/s in the lower part of the river below Jonava. Runoff fluctuations over the year are high, e.g. runoff at the Buivydžiai station in spring time is 192 m^3/s, while in dry season it goes down to 93,9 m^3/s. During the spring floods, the run-off height is about 66-68 mm. The highest floods on the Neris River were observed in 1926, 1931, 1941, 1951 and 1958. The maximal flood on the Neris river usually occurs in March 29 - April 1. The lowest debits during summer-autumn month in the Neris River range from 37 to 61 mm (ref 2).

Forests occupy about 28% of the Neris river basin area, wetlands make up 10% and lakes account for 2.5%. The agricultural sector is not widely developed in this area, with farming land occupying about 134,000 hectares. National and regional parks occupy an area of about 24,000 ha.

Various important ecosystems can be found across the Neris river basin. The Neris is a unique river, because in the territory of Lithuania practically all the bed is natural, except for a segment of several kilometres in the centre of Vilnius where the banks of the river are fortified. The Neris valley is deep, 40-50 meters in depth with distinct terraces. The width of the valley in different places is not equal. It is the broadest near Paaliosė, or about 4 km wide. The majority of the streams of the Neris Regional Park are natural, with only a few dammed for the purpose of energy production.

Hilly areas were formed at the foot of the slopes of the valleys of the Vilnia and the Neris around 13,000 years ago. The longest hill ridges in Lithuania are persevered in the Lyglaukiai geomorphological reserve. The most impressive in the Vilnia valley is the Pūčkoriai exposure, a unique geological monument declared a protected site in 1974. The exposure has been formed by the Vilnia river that expanded sideways and broadened its valley. Its height exceeds 65 metres. The thickness of the old Medininkai ice glacier that was crumpled by later glaciers can be seen in the Pūčkoriai exposure. The moraine and sand layers of different ages are messed up, and in some places they are vertically positioned or have clear wrinkles, curved lumps and wedges[4].

There are important lake ecosystems in the Neris river basin. Long and deep ravines of the Green Lakes formed around 18,000 years ago. They were washed out by the water flowing under the glaciers. Ravines are long, deep and with steep slopes, and deep oblong lakes lie stagnant in the lowest places. Water in the Green Lakes has a unique green colour. This is caused by a great amount of dissolved carbonates in the underground water, which feeds the lakes. Lake Balsys

3 *Nemunas River Basin District. Article 5 report. http://aaa.am.lt*

4 *Verkiai regional park website www.pavilniai-verkiai.lt*

together with its bed is the largest and deepest lake of the group: its slopes rise to 40 metres above the water level, while its deepest point is almost of the same depth[5].

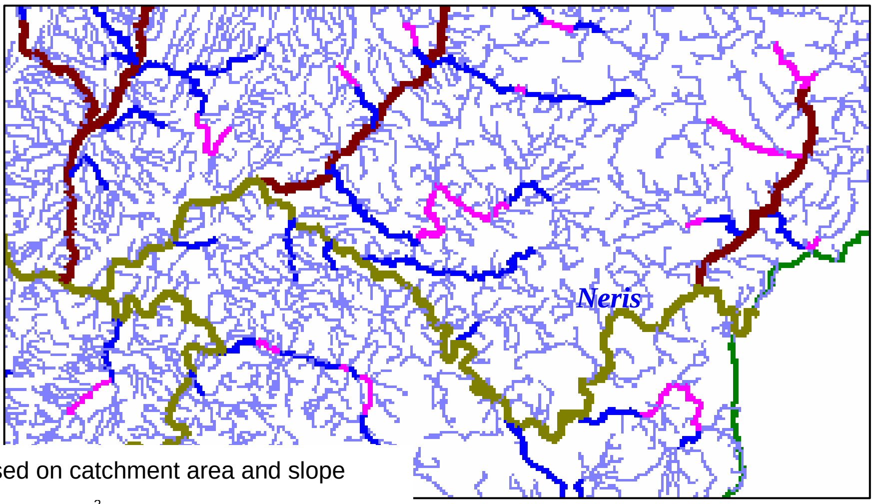
Forest ecosystems. In the territory of the Neris Regional Park, the Dūkštos oak-wood, one of the oldest and biggest oak-woods in Lithuania, has survived. The area of the oak-wood is 302 ha. The most valuable part of the oak-wood is a nature reserve. Incidentally, the Neris Regional Park is a regional park most densely covered with forests in Lithuania: forests occupy even 95 % of the park's territory. Today forests cover about one third of the Neris River Basin area. Pine forests prevail in the Neris Regional Park, where they occupy 80 pct of the total forest area. Cowberry pine forests prevail in the driest parts of the continental terraces, on the sands and gravels that are the most barren in nutrient materials. Mixed cowberry-bilberry pine forests with spruces are found in the lower places of the terraces. Pine forests with oaks, which most often lie on the steep slopes of the Neris and on the edges of the upper terraces, grow in the most fertile plant habitats, on the carbonaceous sands and gravels[6].

2.3 Water system characteristics

The hydrological system in the Neris river basin is comprised of longer and smaller tributaries; the density of hydrographical network is high, as the number of lakes and rivers in the basin is quite large. The total number of small tributaries is 870, with a total length of 1,970 km, and 214 rivers longer than 3 km have a total length of 1,855 km (Gailiušis, Jablonskis and Kovalenkovienė, 2001).

Rivers in Lithuania are divided into four classes according to the size of the catchment area. Rivers with catchment areas smaller than 10 km^2 are included in the group of rivers with catchments smaller than 100 km^2. Rivers with a catchment between 100 and 1000 km2 are further divided according to the average slope of the river with a slope of 0.7 m/km as the dividing criteria.[7] The river typology in the Neris River Basin is provided in the picture below.

Figure 2. River water bodies in the Neris river sub-basin



River types based on catchment area and slope

- > 10,000 km^2
- 1,000 – 10,000 km^2
- 100 – 1,000 km^2, slope >0.7 m/km
- 100 – 1,000 km^2, slope <0.7 m/km
- < 100 km^2

[5] Verkiai regional park website www.pavilniai-verkiai.lt

[6] Neris regional park website www.neriesparkas.lt

[7] Carl Bro as, NERI and AAPC. Technical report TN B: Typology for surface waters. Project „Implementation of the EU Water Framework Directive, Lithuania, Meeting 2006 deadlines (2004) Vilnius

For WFD purposes, six main groundwater bodies and 16 sub-bodies were identified. The Upper-Lower Cretaceous, Quaternary of South-Eastern Lithuanian and West Zemaitija, as well as the southern section of the Upper-Middle Devonian groundwater bodies were assigned to the Nemunas River Basin District. The major section of the Middle-Upper Devonian groundwater bodies lies in the Nemunas basin, but its Northern part was assigned to another basin, the Lielupė RBD. Since the Upper-Middle Devonian groundwater body uses deep aquifers, the body was "split" and assigned to the two RBDs for purposes of administration of groundwater use and planning of shallow groundwater protection measures. The Nemunas basin includes 14 sub-bodies. The Quaternary, Cretaceous, Jurassic, Permian and Devonian aquifers are used for water supply[8].

2.4 Characterisation of water use

The main water users in the Neris river sub-basin are households, industries and fisheries. Water needs in agriculture are not very high, since Lithuania is in a zone of surplus humidity where precipitation levels are quite high. Water use for recreation is gaining increased importance in general in Lithuania; in the Neris sub-basin it has a very high potential due to a variety of landscapes and attractive water sites.

Although the Neris River stretch of 165 km length (from the mouth) is an inland waterway of national significance, practically there is no navigation there. A shorter stretch (7 km) of the Neris in Vilnius has the status of an inland waterway of local importance where a single motor boat with a capacity for transporting up to 30 people is used in summer. The potential for navigation is much greater than currently used; therefore, the municipalities of Vilnius and Jonava are developing plans for future recreational navigation on the river.

Commercial fishing has been banned on the Neris river since 1970 (Kilkus, 1998), licensed fishing is very limited, with the number of licences for catching salmon, sea trout and other valuable fish restricted to 50-300 per year. There are four pond farms in the Neris River basin where commercial fishing is allowed.

Hydro energy production in the Neris River basin is not very high. There are no hydropower plants on the Neris River itself, since construction of such plants on the river is prohibited by law. Three small-scale hydropower plants were constructed on the Neris' tributaries Musė, Vokė and Vilnia. Annual energy production capacity of the three power plants is 3.5 million kWh, while the total energy production in small hydropower plants in Lithuania in 2005 was 66.1 GWh[9].

Speaking of the other water uses, affecting the hydrological system of the Neris river, a Vileika pond, located in the territory of Belarus, can be mentioned. In 1974, a pond of 260 million m^3 was constructed on the Neris (Vilija) river above the town of Vileika for water transfer via the river Vilija and the channels to Minsk (Gailiušis, Jablonskis and Kovalenkovienė, 2001). According to the design of the water reservoir, average annual runoff below the pond was about 277 million m^3 and it could not go below 32 million m^3 (minimum sanitary runoff) (Kilkus, 1998). Due to the construction of the Vileika pond and the water transfer to the Minsk water reservoir, annual debits in the Neris have decreased by 6.71 m3/s since 1977 (Gailiušis, Jablonskis and Kovalenkovienė, 2001).

A number of cultural and historical sites, valuable landscapes and meandering rivers can be found in the basin; therefore several protected areas exist in the region. There are four protected areas in the Neris River sub-basin, which fall under the category of complex protected areas, where preservation, protective, recreational and economic areas are interconnected following a general programme of protection, regulation and use. These are the Trakai Historical

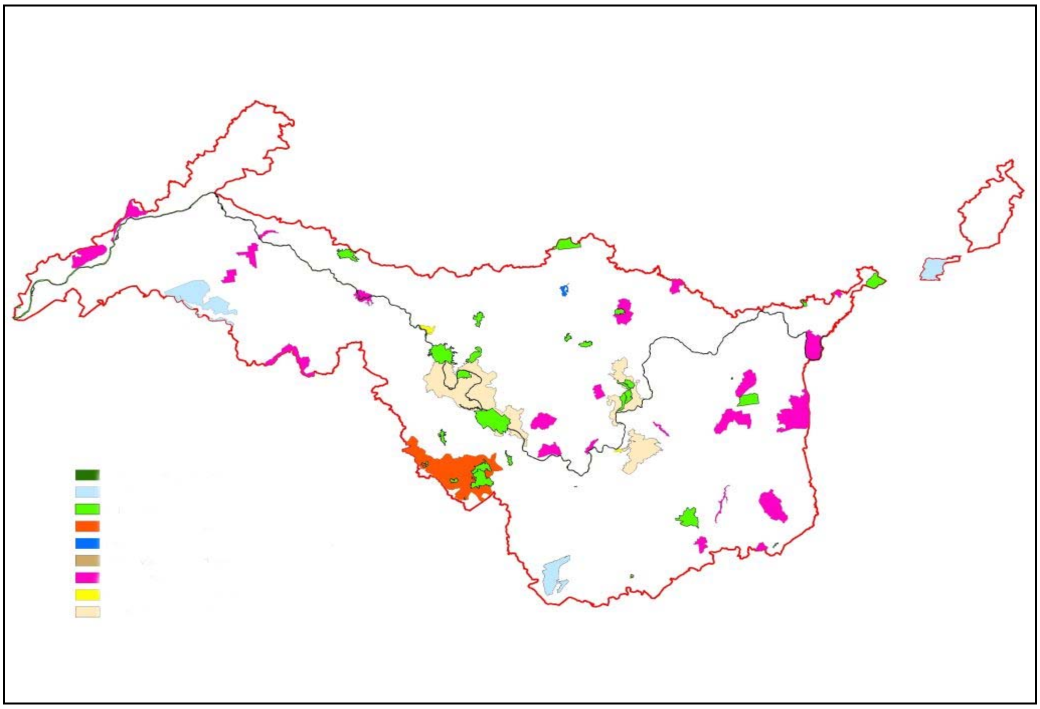
[8] *Nemunas River Basin District. Article 5 report.* http://aaa.am.lt

[9] *Lithuanian Energy Institute (2006) Energy in Lithuania 2005. Annual report.*

National Park (8,200 ha), Neris Regional Park, Verkiai Regional Park and Pavilniai Regional Park. The Neris Regional Park with a territory of 10,587 ha has been established in order to preserve the expressive landscape of the river valley, the distinctive flora and fauna, the unique system of the Neris midland turns and natural tributaries, as well as the cultural heritage. The Verkiai Regional Park (total area 2,670 ha) consists of two quite different landscapes: the southern part where the values of cultural heritage dominate, and the northern part where the values of the natural landscape are preserved. The Pavilniai Regional Park, measuring the smallest area among all regional parks of Lithuania, or 2,150 ha, has been established for preserving landscapes characterised by a unique relief with great differences in height, reaching 100 m[10].

After 2004, the network of protected areas has been complemented with 41 Natura 2000 sites, established for the protection of important areas under the Birds and the Habitats Directives. The location of protected areas is mapped out in the figure below.

Figure 3. Neris River Basin protected areas



Source: State Service for Protected Areas

Legend: Dark green – Restoration sites; blue – Biosphere polygons; light green - Habitats Directive areas; red – National parks; dark blue – Birds Directive areas; brown – Reserve areas; pink – State reserves; yellow – Strict state reserves; light pink – Regional parks.

Important from the point of view of water hydrology are seven hydrographical reserves established in the Neris river basin, aimed at preserving distinctive stretches of rivers with typical hydrographical-landscape elements (rifts, meanders, islands, etc.). These reserves fall under the category of Territories of Conservational Preservation Priority. Hydrographical reserves situated in the Neris River Basin are listed in Table 1.

[10] *http://www.travel.lt/turizmas/selectPage.do?docLocator=CA05FE28D97911D8BFFE746164617373*

Table 1. Hydrographical reserves situated in Neris River Basin territory

Name of the reserve	River	Length of the river stretch, km
Buivydžių	Neris	10
Aliosos	Neris	40
Vilnios	Vilnia	9
Kenos	Kena	10
Riešės	Riešė	9
Bražuolės	Bražuolė	4
Lietavos	Lietava	6

Source: Compiled by the author based on the Neris Regional Park Description in www.neriesparkas.lt

Water use for recreational purpose has gradually increased over the last years. Protected areas are especially attractive for tourism and recreational activities. Investments for adaptation of protected areas for tourism over the period of 2003-2006 amounted to about 10 million litas. Especially rapid expansion is observed in the countryside tourism sector, which is mostly developed in areas abounding in water bodies. In 2005, about 15% of countryside tourism sites were situated in the Vilnius county. In general, in Lithuania the amount of local tourists visiting rural tourism sites from 2004 to 2005 increased by 52%, while the number of foreign tourists went up by 40%[11]. The Neris river basin, rich in valuable water sites, will most likely experience even faster development of tourism and especially of recreational activities.

A number of lakes (about 11) in the Vilnius county, as well as certain sites in the Neris river in Vilnius and Jonava, are designated as official bathing sites where water monitoring points are established.

2.5 Economic analysis of water use

Average data from 2004-2005 show that annual water consumption in the Neris river slightly exceeds 60 million m^3, of which 54 pct (~34 mln m^3) comes from groundwater. As in the whole country, only groundwater is used for drinking purposes in the case study area.

Currently, the population of the Neris river basin is about 700,000 inhabitants, of which 76% live in the capital Vilnius, and about 16% reside in 17 towns with more than 2,000 inhabitants. According to statistics, the rate of water consumption in the household sector in the Neris River sub-basin in 2004-2005 was about 47% of total water consumption. Currently, water consumption per capita in this sub-basin is higher than in the other sub-basins and amounts to about 80 litres of water per person per day. It is expected that the water consumption by the household sector in the Neris sub-basin will grow and may reach 145 litres by 2015.

Neris sub-basin region has well developed industrial infrastructure and can attract more investments than less developed regions. Industrial entities use both groundwater and surface waters for their needs; water consumption in the sector reaches 25% of all water consumed, of which groundwater comprises 23%. Currently, there are 43 IPPC sites in the sub-basin, and this number is expected to increase until 2015; therefore, the industry sector will remain a significant driver for pressures in the Neris sub-basin.

[11] *Lithuanian State Department of Tourism. Draft National Tourism Development Programme for 2007-2010.*

In most urban areas in Lithuania, industrial wastewater and wastewater from households is collected and treated in the same wastewater treatment facilities. The current situation in the Neris RBD with wastewater treatment is presented in Table 2.

Table 2. Number of Urban WWTPs in Neris River Basin

Size of agglomeration (No of inhabitants)	Current situation, 2005		Plan for 2015
	No of agglom.	No of UWWTP	No of UWWTP
>10,000	4	4	4
2,000 – 10,000	14	13	14
500 – 2,000	36	22	36
200 - 500	72	50	55

Source: Compiled by authors from data of EPA and Lithuanian Water Investment Master Plans

Agricultural users and pond farms mainly use the surface waters. Consumption of water in the pond farms in the Neris sub-basin is substantially higher than in agriculture. Annual water consumption in fishponds is about 13 million m^3 per year (~20% of total water consumption in the basin), whereas the water amount used in agriculture makes up less than one percent of the total water use in the basin.

Agricultural land in the basin occupies about 134,000 hectares, 58% of which is arable land, 38% is meadows and pastures and the remaining 4% is fruit and berry plantations. A number of livestock farms in the basin amounts to about 300, where the majority of them (275) have 10 - 199 livestock units (LU), 13 farms have 100 -200 LU and 18 have more than 300 LU.

3. PRESSURE, IMPACT, AND RISK ANALYSIS

3.1 Significant pressures impacting on water status

Pressures impact analysis carried out for the Nemunas River Basin District has revealed that the main pressures are wastewater discharge, agricultural activities and physical alterations of natural watercourses, of which two are applicable for the Neris River Sub-basin:

Wastewater discharge:

- Point source as direct discharge with no or insufficient treatment
- Diffuse source as individual discharge with no or insufficient treatment such as septic tank

Agricultural activities

- Point source as direct discharge from manure stacks
- Non-point (diffuse) agricultural sources

Current water quality modelling with the MIKE BASIN software has been carried out within the project "Procurement of Services for the Institutional Building for the Nemunas River Basin Management", with the main task of developing the River Basin Management Plan for for Nemunas RBD. In the model, point source loads comprise the loads from the monitored municipal and industrial outlets, which are reported to the Environmental Protection Agency (EPA) of Lithuania. Domestic loads comprise the loads from sewered inhabitants living in settlements whose outlets are not reported to the EPA or are not included into the EPA point source database. Loads from non-sewered inhabitants cover all settlements larger than 200 inhabitants where there are no wastewater collection and treatment facilities. Agricultural loads comprise the loads from livestock units, as well as from the application of P and N fertilisers.

The overall pollution load by the sector is presented in Table 3. The figures reflect that agriculture is the main source for pollution by BOD_7 and NO_3, while point sources generate more pollution by NH_4 and total phosphorus.

Table 3. Pollutant loads released into the Neris river sub-basin from different pollution sources[12]

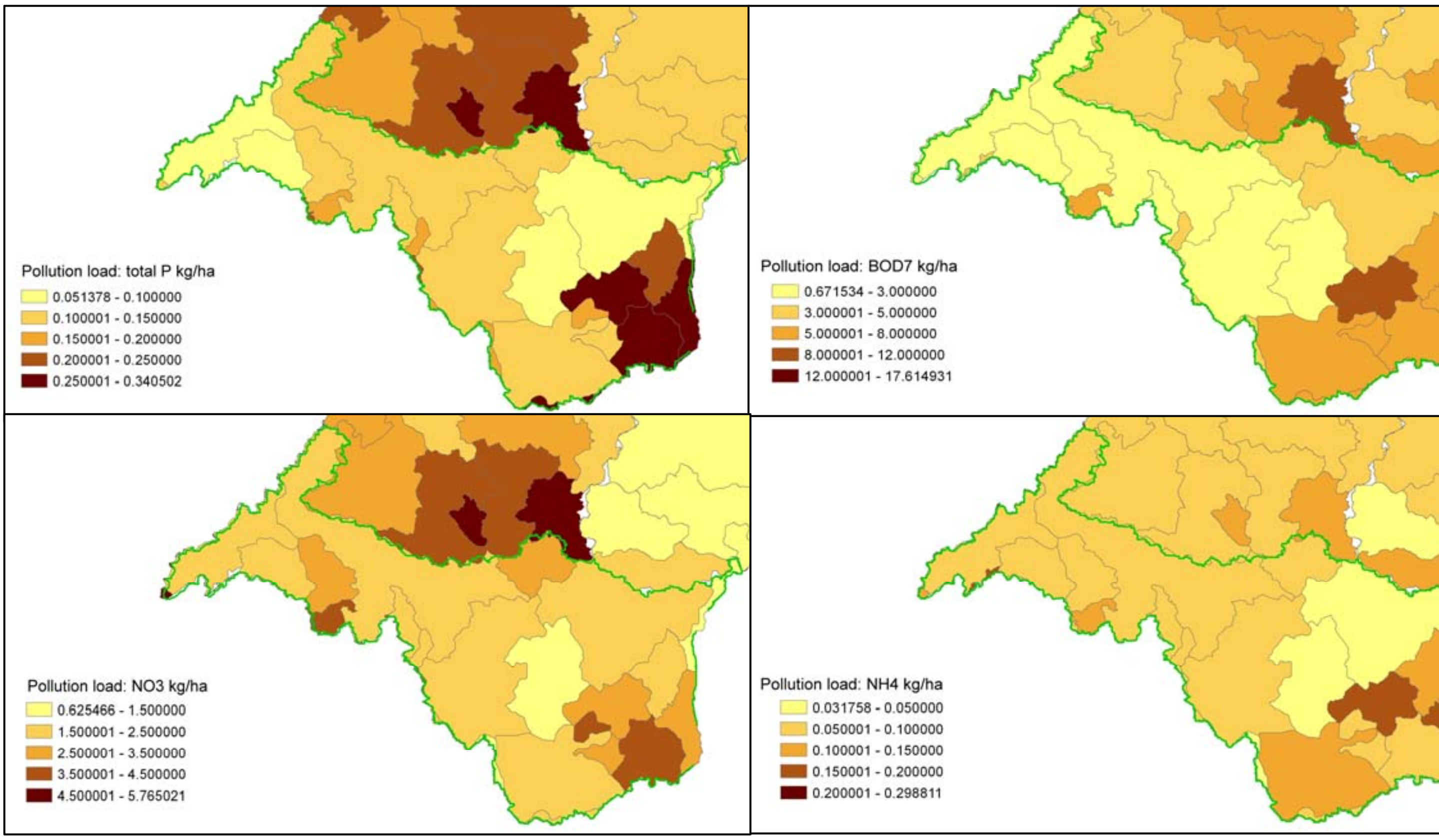
Pollutant	Total load, t/yr	Non-point loads, t/yr		Point loads, t/yr	
		Agriculture	Non-sewered inhabitants	Point sources	Domestic loads
BOD_7	**2,270**	1,374	106	454	336
NH_4	**160**	33	0.5	126	0.6
NO_3	**1,242**	897	16	307	22
TP	**128**	55	1	67	5

Source: Modelling results of the project "Procurement of Services for the Institutional Building for the Nemunas River Basin Management"

Pollution loads by the substance are presented in Figure 4. The Neris River sub-basin boundaries in the picture are marked in green.

[12] *Technical Note on Pressures and Impacts. Project "Procurement of services for the Institutional building for the Nemunas River Basin management"*

Figure 4. BOD and total phosphorus load (kg/ha) in Neris River Basin



Source: Modelling results of the project "Procurement of Services for the Institutional Building for the Nemunas River Basin Management"

Water quality problems occurring due to pollution loads are summarised in Table 4:

Table 4. Water quality problems in Neris catchment

Substance	***Polluted water body***	***Pollution sources***
BOD_7	Neris (from the border to the Lomena tributary)	Transboundary and point pollution, mainly Vilnius WWTP
	Nemezis (downstream Nemezis and Skaidiskes)	Nemezis WWTP, Skaidiskes WWTP
	Lomena (downstream Kaisiadorys)	Kaisiadorys WWTP
	Suderve, Bezdone	Small point pollution from direct household and industrial discharges and WWTPs
Total phosphorus	Neris (from the border to Zeimena river)	Transboundary pollution
	Neris (downstream Vilnius)	Vilnius WWTP
	Rudamina (downstream Rudamina)	Rudamina (Vilnius poultry farm) WWTP
	Nemezis (downstream Nemezis and Skaidiskes)	Nemezis WWTP, Skaidiskes WWTP
	Voke (downstream Rudamina)	Rudamina (Vilnius poultry farm) WWTP
	Aliosa (downstream Elektrenai)	Elektrenai WWTP
	Lomena (downstream Kaisiadorys)	Kaisiadorys WWTP
	Suderve, Cekone	Small point pollution from direct household and industrial discharges and WWTPs
Ammonia	Ammonia concentrations above 0.08 mg/l in Vilnia, Rudamina, Voke, Neris (downstream Vilnius), Lomena, Aliosa streams	
Nitrates	Slightly increased concentrations of nitrates in Rudamina, Voke, Aliosa, and Lomena streams	

Source: Estimations of the project "Procurement of Services for the Institutional Building for the Nemunas River Basin Management"

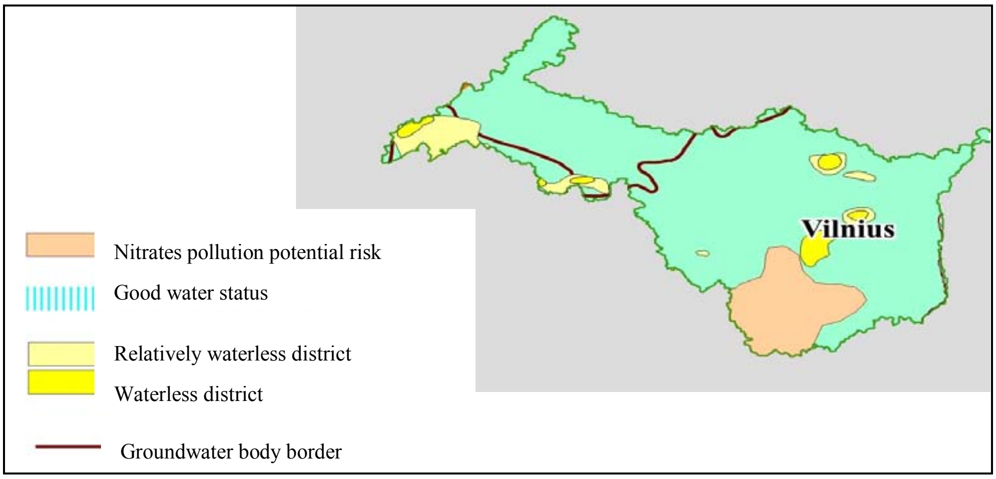
Pollution by dangerous substances has not been modelled, and information on the occurrence of dangerous substances in general is very limited. However, some kind of picture may be drawn from the results of the recent project "Screening of Dangerous Substances in the Aquatic Environment of Lithuania" funded by the Finnish Ministry of Environment.

Urban wastewater discharges and transboundary pollution are the main sources of pollution by dangerous substances. The results of the project have revealed that low quantities of metals, octylphenol and polycyclic aromatic hydrocarbons were detected in the water of the Neris River at the border. Tributyltin was detected in the river bottom sediments in a concentration higher than EQS for sediments. Wastewater from two cities, Vilnius and Jonava, is a source of nonylphenols, organotin compounds, phtalates and their ethoxylates, and brominated diphenylethers. Concentrations of organotin compounds in the Jonava wastewater treatment plant are close to the existing EQS.

3.2 Impacts on surface and groundwater bodies

Agricultural pollution is the main source of shallow groundwater pollution by nitrates. In many regions of Lithuania, shallow groundwater is polluted by high concentrations of nitrates and this causes a risk for deeper layers of groundwater. Some areas with a risk of groundwater pollution by nitrates have been identified in the Neris river basin (Figure 5).

Figure 5. Groundwater pollution risk in Neris River Basin area



Source: Lithuanian Geological Survey, 2006

Impacts of surface water pollution on the fish population have been noticed in the Neris river. The fish population investigations in the Neris river in 2000 revealed that water pollution below Vilnius had a negative impact on both the fish population size and reproduction[13]. For example, the reproduction conditions for the species Barbus barbus and salmon in the polluted river stretches are significantly reduced. A strong relationship between water pollution and the population size of Aspius aspius was identified: the total fish biomass in the polluted water was significantly lower than in the unpolluted stretches.

[13] *Virbickas T., Kesminas V. Ichthyofauna of the Neris River: diversity, abundance, state. Acta Zoologica Lituanica 10 (4): 9-23*

3.3 Water bodies at risk of not achieving a good status

The project "Procurement of Services for the Institutional Building for the Nemunas River Basin Management" has proposed the following thresholds for the identification of water bodies at risk (WBR) in the Nemunas RDB with regard to water quality elements:

- average annual concentration of BOD_7 > 3 mgO_2/l,
- average annual concentration of ammonia > 0.08 mg/l,
- average annual concentration of nitrates > 1.3 mg/l,
- average annual concentration of total phosphorus > 0.11 mg/l

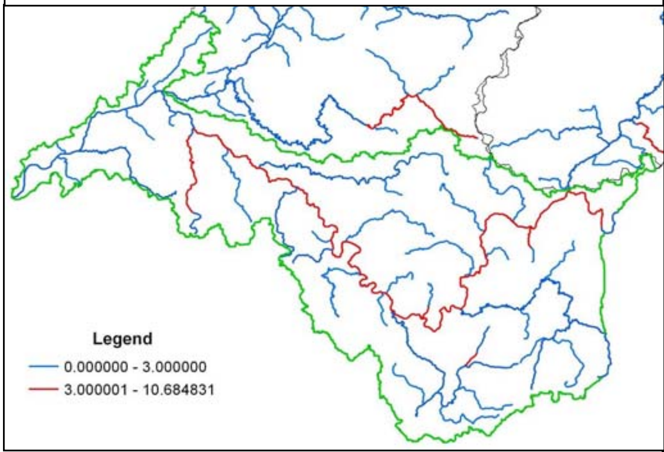
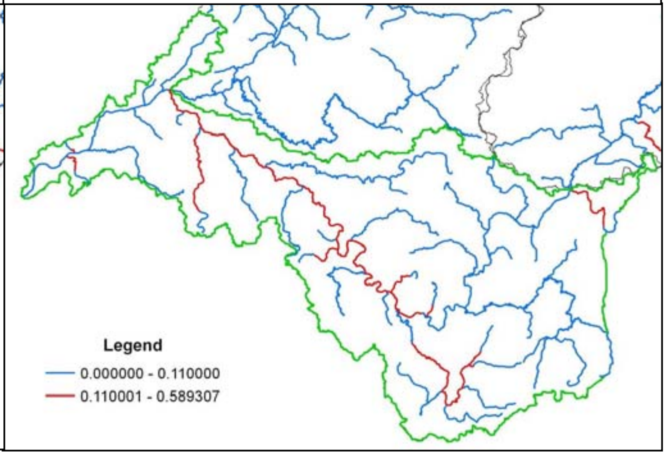
Based on these thresholds, water bodies at risk due to pollution by BOD and phosphorus have been identified. No water bodies have been identified as those at risk with regard to nitrates and ammonia yet, as the EPA has not adopted the criteria for that. The following water bodies at risk have been identified in the Neris River Basin:

Table 5. Water bodies at risk in the Neris River Basin

WBR with regard to total phosphorus	
Water bodies (rivers/streams) at risk	**Sources leading to classification**
Neris (from the border to Zeimena river)	Transboundary pollution
Neris (downstream Vilnius)	Vilnius WWTP
Rudamina (downstream Rudamina)	Rudamina (Vilnius poultry farm) WWTP
Nemezis (downstream Nemezis and Skaidiskes)	Nemezis WWTP, Skaidiskes WWTP
Voke (downstream Rudamina)	Rudamina (Vilnius poultry farm) WWTP
Aliosa (downstream Elektrenai)	Elektrenai WWTP
Lomena (downstream Kaisiadorys)	Kaisiadorys WWTP
Suderve	Direct discharges from small settlements and WWTP
Cekone	UWWTP and industrial discharges
Zversa	Stormwater and industrial direct discharges
Marilė	Direct discharges from small settlement and industrial WWTP
Water bodies at risk with regard to BOD_7	
Water bodies (rivers/streams) at risk	**Sources leading to classification**
Neris (from the border to the Lomena tributary)	Transboundary and point pollution, mainly Vilnius WWTP
Nemezis (downstream Nemezis and Skaidiskes)	Nemezis WWTP, Skaidiskes WWTP, non-point pollution
Lomena (downstream Kaisiadorys)	Kaisiadorys WWTP
Suderve	Direct discharges from small settlements and WWTP
Bezdone	UWWTP and industrial discharges

Water bodies at risk have been mapped out in Figure 6. The Neris sub-basin is delineated in green, and the water bodies at risk are shown in red.

Figure 6. Water bodies at risk in the Neris River Basin

Water bodies at risk with regard to pollution by BOD_7	Water bodies at risk with regard to pollution by total P
	

Source: Modelling results of the project "Procurement of Services for the Institutional Building for the Nemunas River Basin Management"

4. WATER POLICY ISSUES IN THE BASIN

The Water Framework Directive implementation system in Lithuania is fairly centralised: a single body, the Lithuanian Environmental Protection Agency (EPA), is assigned as a Water Basin Management Authority responsible for the implementation of the Water Framework Directive. Some tasks, however, are transferred to other central-level institutions: Marine Research Centre, State Geological Survey, State Hydro-Meteorological Service and Marine Research Centre. Only information collection is more dispersed: among other institutions, eight Regional Environmental Protection Departments are involved here. In addition, the Regional Departments will be involved in control of the implementation of river basin district management plans. Supporting bodies, or Coordination Boards, have been established in each river basin district in order to ensure co-ordination and collaboration among different institutions. Their main task is to coordinate and harmonize stakeholders' interests in the preparation and implementation of RBD management plans.

Water quality issues in the Neris sub-basin were described in Section 3. The main issues in the sub-basin are related to water pollution by BOD, nutrients and dangerous substances. River modification, alteration, as well as resource overexploitation issues are not so acute in the Neris sub-basin.

The Ministry of Environment, as the main developer of water policy in Lithuania, has set the following priority tasks for the water sector in its Water Resources Management Strategy for 2002- 2016:

- Prevent deterioration of, protect and improve the condition of water ecosystems
- Reduce the anthropogenic impact on the condition of water resources
- Ensure availability of drinking water of appropriate quality for all Lithuanian residents and preserve it for future generations
- Improve water resources use and management

More specific objectives include:

1. Improvement of water quality of surface water bodies by cleaning up of water bodies damaged by past pollution.
2. Renovation and extension of water supply and wastewater treatment systems (Development and modernisation of water supply and wastewater collection and treatment infrastructure; Development of sludge treatment infrastructure; Construction of storm water treatment plants).

The mentioned objectives and tasks are directly related to the implementation of the WFD in Lithuania. The Nemunas is the largest river basin in Lithuania, covering 80% of its territory. The river basin district programme of measures will firstly be developed for this basin district. A few steps of the WFD implementation have already been carried out:

After conducting pressures-impacts analysis and economic analysis, significant water pressures and drivers for pressures were identified. Assessment of the future development trends and a baseline scenario were developed. The water quality modelling, based on the findings of the former tasks, leads to the identification of 'gaps' and water bodies at risk. Fourteen water bodies at risk have been identified in the Neris sub-basin. The next step to be implemented is screening of the measures and performance of cost-effectiveness analysis of the measures. Cost-benefit analysis needed for evaluation of the disproportionality of costs is of special interest for decision makers, since it will help to ground decisions regarding the water quality objectives.

Another important policy issue is implementation of the cost recovery principle imposed by the WFD. Currently, environmental costs (though not reflecting real environmental damage or benefit values), as a necessary element of water price, are included in the water price in Lithuania through natural resources abstraction taxes and water pollution charges. Valuation of environmental costs/benefits will certainly improve the understanding of policy makers about the structure and full cost recovery elements of the water price.

As shown above, the major water user in the Neris (and the Nemunas) river basin is the domestic water consumption sector. Moreover, many industrial users are tied to the centralised municipal water supply systems; therefore, cost recovery issues can only be analysed based on municipal water supply and wastewater collection and treatment systems. Separate pricing systems for other users simply do not exist.

The average price for water supply and for wastewater treatment in 2005 ranged from 3.63 LTL/m^3 in the first and the largest water companies' group, to 4.74 LTL/m^3 in the smallest companies' group. It made up approximately 0.6% - 0.8% of the average disposable household income (while the existing average level of consumption equalled to 70 l/inh/day in 2005) in the Nemunas river basin territory. The tariffs in different Lithuanian municipalities are quite different, reflecting their respective different situation. On average, the existing tariff is not sufficient to cover all costs; therefore, according to the existing financial and accounting practices in Lithuania, a considerable part of water companies is operating on a loss-making basis. Only the utilities serving the larger population are profitable, as explained by economies of scale. The main reasons for the delays in tariff increases are social and political. The delays usually hinder implementation of cost recovery related targets. Nevertheless, the number of profitable water companies is growing.

It must be noted that the largest water company, Vilnius Water Company, is located in the Neris river basin district area.

It is expected that water prices levels will be increased to offset existing losses in the next years. Additional tariff increases would be required to implement the proposed capital investment programmes and to take polluter and user pays principles into account. Inclusion of environmental costs and, especially, application of valuation studies for setting environmental costs' levels will require, though, more political discussions and a better understanding of the WFD principles.

5. ERC ANALYSIS AND METHODOLOGICAL ISSUES

5.1 Main water-related goods and services provided in the basin

The Neris River Basin's aquatic system provides direct consumptive goods and services from both groundwater and surface water. Water as a consumptive good used for residential needs, food production industry and livestock watering comes from groundwater, while water for agricultural irrigation and manufacturing processes comes from both groundwater and surface waters.

Water as a non-consumptive good is used for hydropower production and navigation (transportation of goods and people), however, these uses are not widespread in the Neris basin. Such goods as recreational swimming, boating and angling are widely used and have a big potential for increased use. The main goods and services provided in the basin are listed in Table 6.

Table 6. Goods and services provided by the aquatic system in the Neris River Basin

	Goods and services provided by surface waters system	**Categories**
A	Water for residential use	consumptive; use values, offstream
B	Water for landscape	non-consumptive; use values; offstream
C	Water for agricultural irrigation	consumptive; use values, offstream
D	Water for manufacturing processes	consumptive; use values, offstream
E	Water for hydropower plants	non-consumptive; use values, offstream
F	Water for navigation	non-consumptive; use values, offstream
G	Transport, treatment and medium for waste and other by-products of human activities	non-consumptive; use values; instream
H	Sediment removal	non-consumptive; use values; instream; indirect
I	Toxicant export	non-consumptive; use values; instream; indirect
J	Biological diversity provision	use and non use values; offstream/ instream; indirect
K	Recreational activities (swimming, boating, angling)	non-consumptive, use values; offstream/ instream
L	Fishing, trapping and plant gathering	non-consumptive, use values, offstream/instream
M	Cultural value provision	non-use values; offstream
N	Historical value provision	non-use values; offstream
O	Aesthetic value provision	non-use values; offstream
P	Wilderness value provision	non-use values; offstream

The value of a change in quality of a good or service described above can be derived from the change in the value of the stream of benefits.[14] This means that the value of the alteration of the water system to the state, where water status is good, can be derived from the value of benefits the altered water system provides.

The total value of the improved water quality in the Neris River Basin will be a sum of use values and non-use values. The goods from A to L (see Table 6) hold use values, while the services from M to P hold non-use values. The biological diversity provision holds both use and non-use values.

[14] *Economic Valuation of Environmental and Resource Costs and Benefits of Water Uses and Services in the Water Framework Directive: Technical Guidelines for Practitioners. Draft Deliverable D21. Project Aquamoney*

5.2 Type of ERC analysis and proposed methods for the valuation of ERC

Water quality in a number of rivers of the Neris River Basin currently does not meet requirements for the good water status. Measures will be taken to improve the water status and to meet the requirements of the Water Framework Directive. Environmental benefits (total economic value) of the water system improvement will be assessed in this case study.

The contingent valuation method, currently quite widely applied for the estimation of ERC, will be used for the estimation of environmental benefits in the Neris River Basin. The contingent valuation method has been chosen for the reason that it can be employed for estimating not only use values but also non-use values. Non-use values are expected to be an important part of the total economic value in the Neris river case, where water quality improvement will allow for an improvement of biodiversity. In addition, the case study recently carried out in the Nevėžis river basin has revealed that people value the possibility to preserve and maintain water resources for future generations. The likelihood of similar attitudes existing in the current case study area should not be rejected.

A face-to-face survey will be carried out in the Neris River Basin. A random selection of respondents is planned, however, equal proportions of rural and urban inhabitants will be maintained in order to estimate the values of different goods used in different areas.

5.3 Methodological issues

Scale.

The Neris River Basin is a sub-basin of the Nemunas River Basin District and the valuation study will be carried out at the level of the sub-basin. This spatial scale has been chosen due to the fact that a number of tasks of the WFD implementation (baseline scenario development, sets of programme of measures) are being carried out at the same level. The scale of the river basin district – in our case the Nemunas river basin district occupies about 80% of Lithuania's territory - is not appropriate due to the large area and the complexity of problems existing in the main RBD.

We think that, in addition to scale-related questions, three more methodological issues can be tested during the valuation of environmental costs/benefits in the Neris river basin. These include the sensitivity to scope, substitution and benefit transfer methodological issues.

Sensitivity to scope testing.

Scope insensitivity and embedding are fundamental concerns in contingent valuation studies. An opinion exists that CV surveys are insensitive to the scope of a good to be valued.

Neris River, being the main river in the basin is not the only water body identified as a water body at risk. In the basin there are other streams not meeting water quality requirements. Comparison of benefits provided by water improvement in a single river against benefits provided by water quality change in all of the polluted rivers in the basin is an interesting option.

Substitution.

We expect that a fairly big portion of the population living in the Neris river basin uses other than the Neris river water bodies, especially for recreational purposes. This fact may allow testing substitutability of water resources and their goods and services with other water bodies in the same basin and outside the own basin.

There is a number of lakes in the river basin, providing a range of water uses and especially recreational water uses for inhabitants of Neris River Basin. Testing the substitution effect of these lakes would be the option, where another test of sensitivity to water quality level changes may be incorporated.

Benefit transfer.

This methodological issue seems to be extremely important and interesting to test, because it is directly related to a more "practical" world: decision makers need values for the whole Nemunas river basin district, and two sub-basins currently under analysis, i.e. the Nevezis and the Neris river basins, will provide a basis for such a benefit transfer. Having values of two sub-basins of the Nemunas river basin will allow reliability testing across space and scale, i.e. across the same water bodies within the same national river basin district. The results may be applied in the future for transferability of economic values across national river basin districts in Lithuania.

The planned timescale of the case study is provided in Table 7.

Table 7. Time schedule of the Neris case study implementation.

Task	Proposed date
Initial research of the study area	May 2007
Development of questionnaire	June – July 2007
Pre-testing	August 2007
Survey	September – October 2007
Data analysis	November 2007
Preparation of preliminary report	December 2007
Adjustments, Benefit transfer	January – March 2008

References

1. Economic analysis report: Update of Economic Analysis of Water Uses, baseline Scenario and Cost Recovery (2007)
2. Project "Procurement of services for the Institutional building for the Nemunas River Basin management". 2007 Vilnius
3. Economic Valuation of Environmental and Resource Costs and Benefits of Water Uses and Services in the Water Framework Directive: Technical Guidelines for Practitioners. Draft Deliverable D21 (2007) Project: Aquamoney
4. Environmental Protection Agency (2004) Nemunas River Basin District. Article 5 Report
5. Gailiušis, B. Jablonskis, J. Kovalenkovienė M., Lietuvos Upės. Hidrografija ir nuotėkis (Rivers of Lithuania.Hydrografy and flow) (2001) Lithuanian Energy Institute, Monography. Vilnius
6. Kilkus, K. Lietuvos vandenų geografija (Geography of Lithuanian Waters) (1998) Vilnius
7. Lithuanian Energy Institute (2006) Energy in Lithuania 2005. Annual report.
8. Lithuanian State Department of Tourism. Draft National Tourism Development Programme for 2007-2010.
9. Technical Note on Pressures and Impacts. Project "Procurement of services for the Institutional building for the Nemunas River Basin management". 2007 Vilnius
10. Technical Note TN B: Typology for surface waters. Project „Implementation of the EU Water Framework Directive, Lithuania, Meeting 2006 deadlines (2004) Vilnius
11. Virbickas T., Kesminas V. (2000) Ichthyofauna of the Neris River: diversity, abundance, state. Acta Zoologica Lituanica 10 (4): 9-23
12. Verkiai regional park website www.pavilniai-verkiai.lt
13. Neris regional park website www.neriesparkas.lt
14. http://www.travel.lt/turizmas/selectPage.do?docLocator=CA05FE28D97911D8BFFE746164617373