

# Strategy for Integrated Water Supply, Wastewater Treatment and Disposal Systems for Small Communities in Poland

Case study - Master and Action Plans (MaAP) for the Bystra River Catchment

Phase I, Data gathering



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Abstract This report is the first interim report and presents in general terms the summary of the results of the first phase of the three-phase demonstration project: " Strategy for integrated Water Supply, Wastewater Treatment and Disposal System for Small Communities in Poland: *Case study - Master and Action Plans (MaAP) for the Bystra river catchment*". This first phase consists of Data gathering.

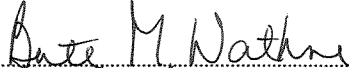
This project is part of the Programme of Bilateral Co-operation between the Norwegian Ministry of Environment and the Ministry of Environmental Protection, Natural Resources and Forestry in Poland. It is implemented by the Norwegian Institute for Water Research (NIVA) and is funded by the Norwegian Pollution Control Authority (SFT). The Institute of Environmental Protection (IOS) performs the Polish co-ordination, sponsored by the National Foundation for Environmental Protection.

This interim report presents an overview of data collected in the studied catchment area, data which is necessary to qualify the river water and to determine the pollution load in order develop an abatement strategy.

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**Strategy for  
Integrated Water Supply, Wastewater Treatment  
and Disposal Systems for Small Communities in Poland**

*Case Study - Master and Action Plans (MaAP) for the Bystra River  
Catchment*

**Interim report**

*Phase I  
Data gathering*

Oslo, April 1997

Grazyna Englund  
Stig A. Borgvang

## Preface

*This report is the first interim report and presents in general terms the summary of the results of the first phase of the three-phase demonstration project: "Strategy for integrated Water Supply, Wastewater Treatment and Disposal System for Small Communities in Poland: Case study - Master and Action Plans (MaAP) for the Bystra river catchment". This first phase consists of Data gathering.*

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*This interim report presents the overview of data collected in the studied catchment area, data which is necessary to qualify the river water and to determine the pollution load in order to develop an abatement strategy. The report is based on the information gathered during the project meetings, visits in the catchment area and the Polish report from Phase I.*

*We would like to thank the Polish partners for their contribution.*

*NIVA's team:*

*Project manager: Ms Grazyna Englund, Research Scientist*

*(Mr Gunnar Fr. Aasgaard was project manager until 1 October 1996)*

*Team member: Mr Stig A. Borgvang, Specialist on Water Resource Management*

*Quality assurance: Dr Harsha Ratnaweera, Research Manager - Wastewater Technology.*

Oslo, April 1997

*Grazyna Englund*

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# Summary

## Background

The seminar between Polish and Norwegian authorities and scientists held in Oslo and Lillehammer in March 1995, on "Strategy for water pollution abatement in view of the Norwegian experience", was the starting point for the current project. The four main communities in the catchment area have established "the Association of the Bystra Valley" whereby these communities agree to implement common activities for environmental protection, restoration of tourism, fishing, recreation. the catchment area of the Bystra river.

## Organisation

The project is a co-operation between the Institute of Environmental Protection (IOS) in Warsaw and the Norwegian Institute for Water Research (NIVA). A Steering Group consisting of representatives from various Polish and Norwegian institutions has been established. The Polish authorities are represented by the Ministry of Environmental Protection, Natural Resources and Forestry and by the National Foundation for Environmental Protection whilst the Norwegian Authorities have a representative from the Norwegian Pollution Control Authority (SFT).

## Objectives

The goal of the project is divided into four categories viz. technology transfer, development of professional competence and network, educational input and follow-up work. It has been defined in three steps, from January 1996 to March 1998. The main project goals are as follows:

- To develop a strategy for integrated water supply, wastewater treatment and disposal systems for small communities in Poland where the river Bystra catchment has been chosen as case study.
- To carry out a general study on existing environmental laws and regulations in Poland related to water resources management and to compare with Norwegian practice/ methodology.
- To carry out a demonstration of methods for environmental impact assessment studies, cost-effective analysis and to introduce integrated water resources planning for a selected area.

## Catchment

The Bystra river catchment is 295,7 km<sup>2</sup> and is located geographically on the Naleczów Plateau. The Bystra river is 34 km long; about 70 km all tributaries included.

The Bystra valley is the ecological regional corridor connecting the protected area system of the Lubelski Highland rivers to Bystra and Wieprz. The larger part of the catchment is covered by protected areas namely:

- Kazimierzowski Landscape Park (27 % of the total catchment area) and its buffer zone (75 % of total catchment area),
- sanatorium area in Naleczów.

The soil is covered by loess, the geological structure and the topography have been strongly influenced by intensive runoff and low water retention in the catchment.

Due to the fertile soil, agricultural activities are dominant in the communities. Agricultural land covers from 62,1 to 88,2 % of the total area of the four main communities, the corresponding figures

for forest land are 5,5 to 12 %. The second main activity of these four communities is associated with health resorts, recreation, and tourism.

Twelve communities are located within the Bystra river catchment, but the four main communities, namely Wojciechów, Naleczów, Wawolnica and Kazimierz Dolny, represent about 73% of the total catchment area. The total area of these main communities equals 215,3 km<sup>2</sup>, the actual population is 28220. There are 2 towns (Naleczów and Kazimierz Dolny) and 63 villages within the catchment.

## Monitoring

Since 1992 has the surface water quality in the Bystra catchment been monitored regularly by the WIOS Lublin (Voivodship Inspectorate for Environmental Protection) at three points in the river Bystra and at three sites where tributaries run into the river Bystra. The yearly average flow in the Bystra river is low, but there is a relatively strong difference between low and high flows.

According to the Polish Surface Water Quality Classification System and the classification made by WIO the river Bystra belongs to class III from the source and 12,6 km down the river, thereafter it is outside the classification system (worse than class III), mostly because of high nutrient concentrations and bacteria contamination. The tributary Czerka belongs to class III, whereas the tributary Bochatniczanka and the stream from Witoszyn are outside the classification system mainly due to very high bacteria content. The overall goal is to implement sufficient measures in order to reach a planned class I water quality in the above mentioned tributaries, as well as in the Bystra river.

## Water supply and sewerage

Waterworks infrastructure is well developed in Naleczów and Wawolnica, where about 80 % of the households are supplied by group water systems. In Kazimierz Dolny about 54 % of the households are connected, and in Wojciechów only 0,6 %.

The sewerage and wastewater treatment infrastructure is very poor. Central sewerage systems with biological treatment exist only in the two towns: of Naleczów and Kazimierz Dolny. Sewage from non-sewerage areas are partly transported to the communal treatment plants partly disposed of into the environment without special control.

The solid waste management is equally poor. Only Kazimierz Dolny has a municipal waste disposal site, other communities transport part of their solid waste outside of the Bystra catchment. There is a designed waste disposal site for three communities, with location in the Wawolnica community, but it has not been built because of disagreements about the consequences of such a site for the tourism.

# 1. Introduction

## 1.1 Project idea/ Background

In March 1995, a seminar on "Strategy for water pollution abatement in view of the Norwegian experience" was held in Oslo and Lillehammer, where representatives from various Polish and Norwegian authorities and scientists discussed the need for a joint project on integrated water supply and wastewater treatment, and disposal sectors for small communities.

## 1.2 Co-operating partners

### Polish team:

- The Institute of Environmental Protection (IOS), ul. Krucza 5/11, 00-548 Warsaw  
Dr. Barbara Osmulska-Mròz and Dr. Pawel Błaszczyk,  
Dr. Maria Fidala-Szope and M.Sc. Jan Borzyszkowski

### Norwegian team:

- Norwegian Institute for Water Research (NIVA), PO. Box 173 Kjelsås, 0411 Oslo  
Project manager: Ms Grazyna Englund, Research Scientist  
(Mr Gunnar Fr. Aasgaard was project manager until 1 October 1996).  
Team member: Mr Stig A. Borgvang, Specialist on Water Resources Management  
Quality assurance: Dr Harsha Ratnaweera, Research Manager - Wastewater technology

### Other participating institutions:

- Communities: Wojciechów, Naleczów, Wawolnica and Kazimierz Dolny
- Biovac, Poland



## 1.3 Steering Group

### Mandate

The Steering Group has a Quality Assurance function. Through regular contact with the project manager (IOS) and the assistance project manager (NIVA) the representatives of the Steering Group have the task to ensure that the main objectives of the project will be obtained.

### Composition

- Prof. Krzysztof Wierzbicki, Chairman of the Steering Committee  
Deputy Director for Scientific Problems at the Institute for Building, Mechanisation and Electrification of Agriculture (IBMER), Warsaw, Poland.
- Ms Maria Apolinarska, M.Sc.  
National Fund for Environmental Protection and Water Management (NFOSiGW), Warsaw, Poland.
- Mr Andrzej Badowski, M.Sc.  
Director of the Regional Board of Water Management (RZGW), Warsaw, Poland.
- M.Sc. Zbigniew Podlaszewski  
Voivodship Office in Lublin, Department of Environmental Protection (WOS), Poland.
- M.Sc. Joanna Bankowska-Kròlikowska  
Deputy director of the Voivodship Inspectorate for Environmental Protection (WIOS), Lublin, Poland.
- Mr. Marian Zaba  
President of the Bystra River Valley Association and of the Wawolnica Community, Poland.
- Mr Gunnar Fr. Aasgaard, M.Sc.  
Director of the Regional Wastewater Competence Centre for Romerike (ANØ), Norway.

## 1.4 Authorities

### Representatives from Polish authorities:

- Ms Eugenia Koblak-Kalinska  
Ministry of Environmental Protection, Natural Resources and Forestry
- Mr Janusz Ostapiuk
- the National Foundation for Environmental Protection

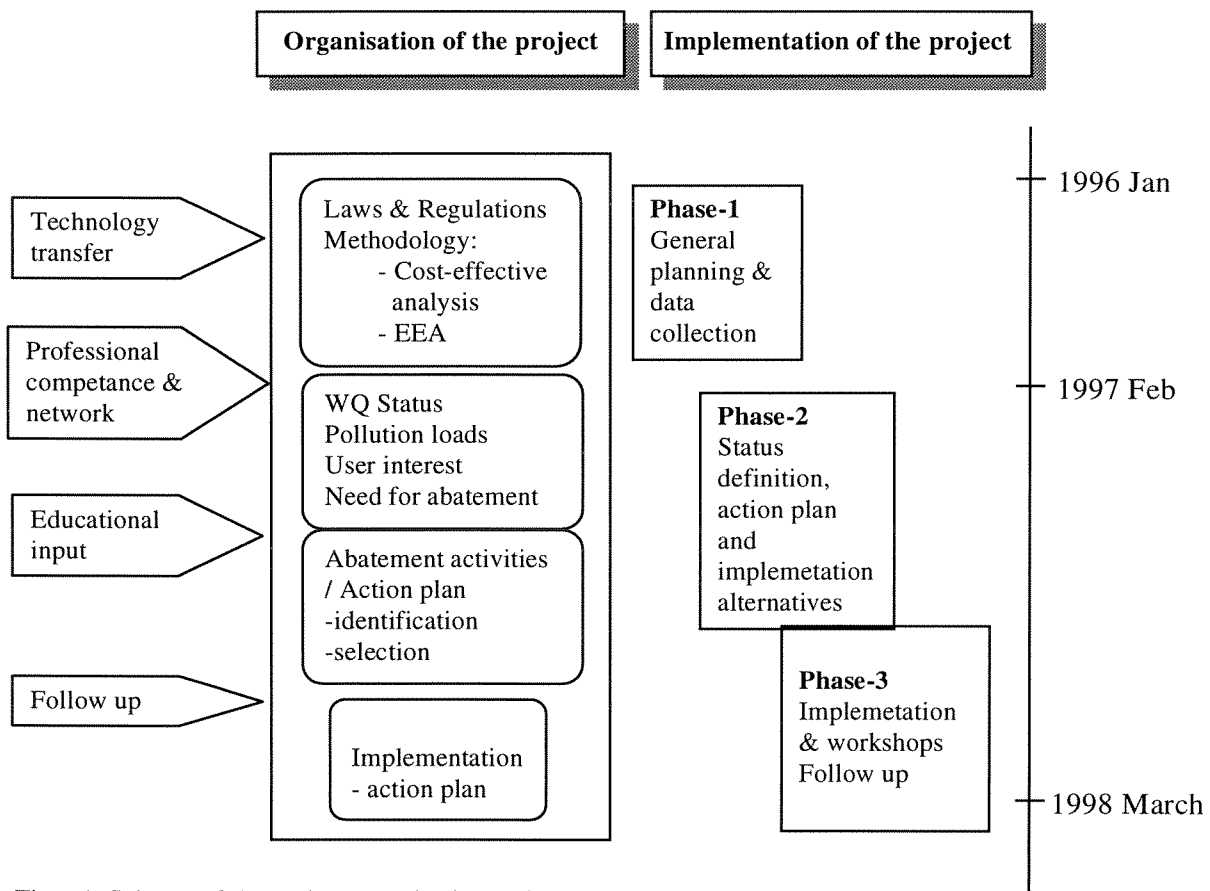
### Representatives from Norwegian authorities:

- Ms Bjørg Storesund, the Norwegian Pollution Control Authority (SFT)  
(Ms Nina Hedlund Markussen, until 1 April 1997).

## 2. Project plan, goals and objectives

The overall organisation of the project and the timetable are shown in figure 1:

Strategy for Integrated Water Supply, Wastewater Treatment and Disposal Systems  
for Small Communities in Poland :  
*Case Study - Master and Action Plans for Bystra River Catchment*



Figur 1. Scheme of the project organisation and implementation.

The main project goals are as follows:

- To develop a strategy for integrated water supply, wastewater treatment and disposal systems for small communities in Poland where the river Bystra catchment has been chosen as case study.
- To carry out a general study on existing environmental laws and regulations in Poland related to water resources management and to compare with Norwegian practice/ methodology.
- To carry out a demonstration of methods for environmental impact assessment studies, cost-effective analysis and to introduce integrated water resources planning for a selected area.

## **3. Phase I - data gathering**

### **3.1 Introduction**

On the basis of the agreed Programme of Bilateral Co-operation between the Norwegian Ministry of Environment and the Ministry of Environmental Protection, Natural Resources and Forestry in Poland IOS selected the Bystra catchment for the demonstration project: " Strategy for integrated Water Supply, Wastewater Treatment and Disposal System for Small Communities in Poland". One main reason behind the choice of the river Bystra catchment area is that this region has high ambitions with regard to environmental conservation, and wishes to promote the region as environmentally sound and healthy.

There is a strong local willingness to preserve the Bystra river environment. To that end the four main communities in the catchment area have established "the Association of the Bystra Valley" whereby these communities agree to implement common activities for environmental protection, restoration of tourism, fishing, recreation. Representatives of this Association have expressed interest in and enthusiasm for the demonstration case study and they have declared their willingness in partly financial support of the implementation part of the project.

### **3.2 General information about the catchment area of the Bystra river**

#### **3.2.1 Surface**

The Bystra river catchment belongs administratively to Lublin Voivodship (south - east of Warsaw) and is located in the unit area of "water balance Z-1" managed by the Warsaw Regional Board of Water (RZWG) 1 (see Annex 1: Map of the Bystra river catchment). The Bystra river catchment is 295,7 km<sup>2</sup> and is located geographically on the Naleczów Plateau. The Bystra river is the right tributary of the Vistula river, connecting Vistula to the Kazimierz Dolny town.

The Bystra river is 34 km long; about 70 km all tributaries included. To the main tributaries belong: the stream from Wojciechowa, the Czerka river, the Bochotniczanka river, the stream from Chruszczowa, the Witoszynski stream and Stocki stream.

The Bystra valley is the ecological regional corridor connecting the protected area system of the Lubelski Highland rivers to Bystra and Wieprz. This valley is also very important for the microclimate of the communities as it influences the thermal and humidity conditions. The larger part of the catchment is covered by protected areas namely:

- Kazimierzowski Landscape Park (27 % of the total catchment area) and its buffer zone (75 % of total catchment area),
- Sanatorium area in Naleczów.

#### **3.2.2 Monitoring**

Since 1992 has the surface water quality in the Bystra catchment been monitored regularly by the WIOS Lublin (Voivodship Inspectorate for Environmental Protection) at three points in the river Bystra and at three sites where tributaries run into the river Bystra. The list of the parameters analysed and the Polish standards for surface water classification are at Annex 2.

Since 1991 is WIOS responsible for the water quality analysis in the Bystra catchment. WIOS has classified the water quality in Bystra and its tributaries according to the Polish Surface Water Quality Classification System. Annex 3 gives, as an example, the monitoring results from 1996. These results show that the river Bystra belongs to class III from the source and 12,6 km down the river, thereafter it is outside the classification system (worse than class III), mostly because of high nutrient concentrations and bacteria contamination. The tributary Czerka belongs to class III, whereas the tributary Bochońniczanka and the stream from Witoszyn are outside the classification system mainly due to very high bacteria content. The overall goal is to implement sufficient measures in order to reach a planned class I water quality in the above mentioned tributaries, as well as in the Bystra river.

The water quality classification system in Poland is based on Regulations of 5 November 1991 of the Ministry of Environmental Protection and Natural Resources. They concern water classification and requirements for wastewater discharged to water and ground (Dziennik Ustaw, 116/1991, pos. 503 (in Polish)). The Regulations define water purity according to specific physical-chemical and biological criteria (Annex 2). Water of Class I may be used for human consumption and food processing. Water of Class II waters may be used for recreation (water sports and public bathing) and animal consumption whereas water of Class III waters may be used only for irrigation and general industrial purposes.

The yearly average flow in the Bystra river is low, but there is a relatively strong difference between low and high flows (see Annex 4).

### **3.2.3 Soil**

The soil is covered by loess; the geological structure and the topography have been strongly influenced by intensive runoff and low water retention in the catchment. There are several small water reservoirs within the catchment, but the maintenance of these reservoirs is insufficient. The topography is extremely diversified with a large number of ravines, which densities varying from 2 to more than 10 km ravines per km<sup>2</sup> (the largest values in Europe). The slopes of the terrain are highest in the northern part of the catchment. Some of the right side tributaries of the Bystra river reach even 13 % declination, while the slopes of the left side tributaries reach 3,3 - 3,5 %.

### **3.2.4 Activities**

Due to the fertile soil, agricultural activities are dominant in the communities. Agricultural land covers from 62,1 to 88,2 % of the total area of the four communities, the corresponding figures for forest land are 5,5 to 12 %. Annex 5 shows the main agricultural activities within the four main communities.

The second main activity of these four communities is associated with health resorts, recreation, and tourism. This is due to unique natural resources, landscape and historical monuments. The seasonal population in this area can vary from several thousands for more than one day visit to 100 000 people for one-day-stay. There are about 30 000 permanent residents in the catchment area.

The Kazimierzowski Landscape Park and Naleczów sanatorium activities are protected and there is therefore little industrial activity in the catchment, and no plans to develop such activities in the future. There is one fruit processing plant (MATERNE - Poland) in the Lopatki community of Wawolnica, some slaughter houses, several workshops and a variety of service units.

### **3.2.5 Population**

Twelve communities are located fully or partly within the Bystra river catchment, but the four main communities namely Wojciechów, Naleczów, Wawolnica and Kazimierz Dolny represent about 73% of the total catchment area. The total area of these main communities equals 215,3 km<sup>2</sup>, the actual population is 28220 and the estimated population in the year 2000 is 37350. There are 2 towns (Naleczów and Kazimierz Dolny) and 63 villages within the catchment.

Waterworks infrastructure is well developed in Naleczów and Wawolnica, where about 80 % of the households are supplied by group water systems. In Kazimierz Dolny about 54 % of the households are connected, and in Wojciechów only 0,6 %.

The sewerage and wastewater treatment infrastructure is very poor. Central sewerage system with biological treatment exist only in the two towns of Naleczów and Kazimierz Dolny. These systems do not serve the total urban area and need modernisation and development. There are small biological treatment units for residential areas and production plants. Two of them are Biovac-type plants. Sewage from non-sewerage areas is partly transported to the communal treatment plants partly disposed of into the environment without special control.

The solid waste management is equally poor. Only Kazimierz Dolny has a municipal waste disposal site, other communities transport part of their solid waste outside of the Bystra catchment. There is a designed waste disposal site for three communities, with location in the Wawolnica community, but it has not been built because of disagreements about the consequences of such a site for the tourism. More detailed information about the 4 main communities is at Annex 6.

## **4. List of activities and publications**

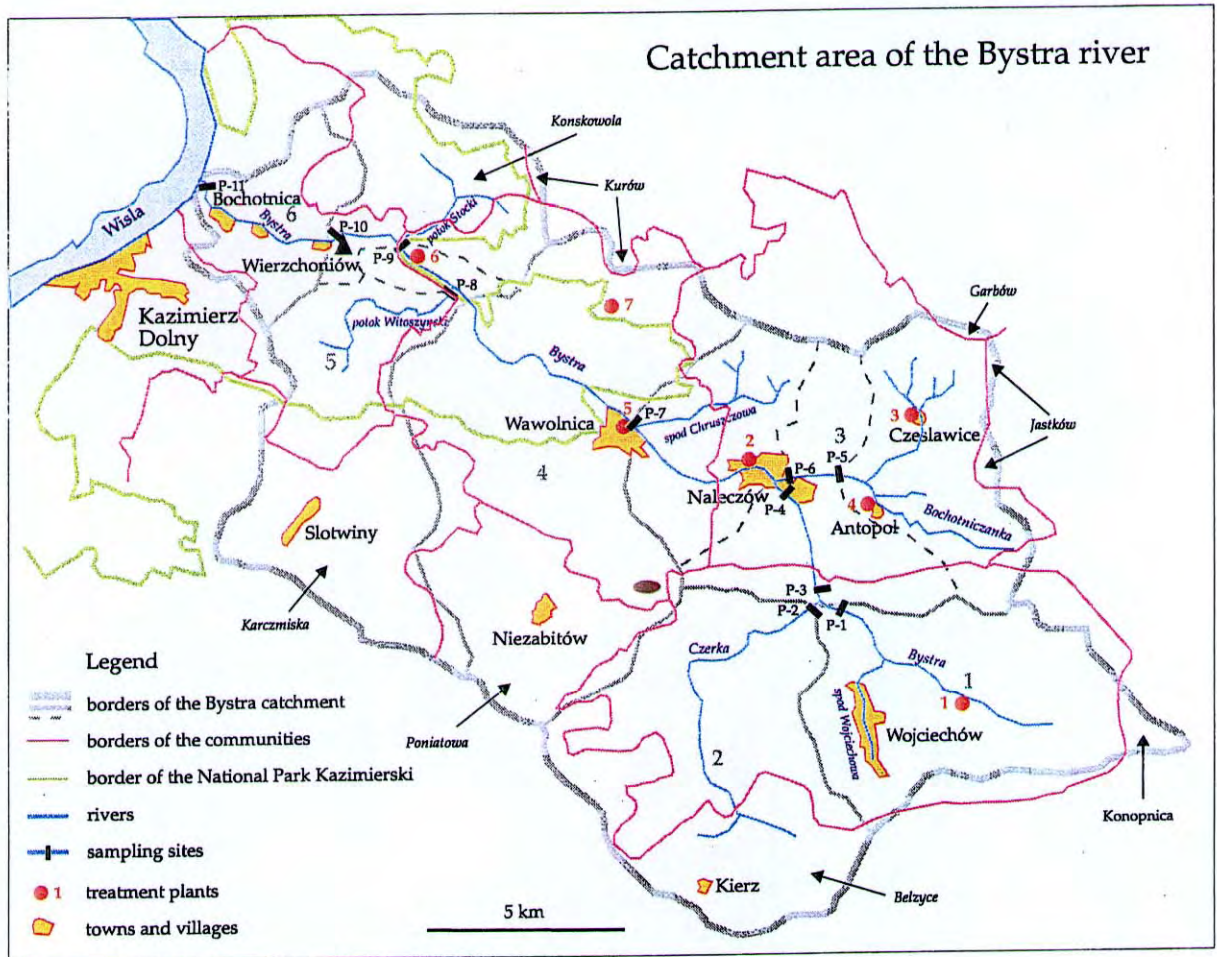
Annex 7 (7.1 - 7.3) shows an overview of the main meetings/seminars which have been held to date in the frame of the current project as well as summary reports from the meetings.

## **5. Further plans and schedule**

Phase 2 of the -project will take place between February 1997 and August 1997 and phase 3 between August 1997 and March 1998 as shown in figure 1. The main elements of the two phases are listed below:

- Evaluation of the results obtained in Phase 1: First working meeting in the pilot study area between the local authority and the representatives of the Steering group: discussion of Phase-1 results and preliminary discussions on possible activities.
- Determination of pollution loads to river Bystra: point and diffused pollution loads.
- Estimation of the water quality and need for abatement: status, user interests and pollution loads.
- Identification of abatement measures and preparation of implementation alternatives.
- Development of Master and Action Plans.
- Second workshop for the decision makers in the pilot area - in order to encourage their participation in the implementation process.
- Development of feasible implementation alternatives.
- Visit in Norway of Polish representatives to discuss the progress of the project and follow-up activities.
- Follow up activities.

# ANNEX 1: Map of the Bystra river catchment (1:100 000)



## ANNEX 2: Polish Water Classification System

Polish Classification System for Fresh Water Systems

| No. | Parameter          | Unit                 | Purity class* |           |           |
|-----|--------------------|----------------------|---------------|-----------|-----------|
|     |                    |                      | Class I       | Class II  | Class III |
| 1   | Temp. air          | °C                   |               |           |           |
| 2   | Temp. water        | °C                   | 22            | 26        | 26        |
| 3   | pH                 | pH                   | 6.5 - 8.5     | 6.5 - 9.0 | 6.0 - 9.0 |
| 4   | Conductivity       | S/cm                 | 800           | 900       | 1200      |
| 5   | Diss.oxygen        | mgO <sub>2</sub> /l  | min. 6.0      | min.5.0   | min. 4.0  |
| 6   | % saturation       |                      |               |           |           |
| 7   | BOD <sub>5</sub>   | mgO <sub>2</sub> /l  | 4             | 8         | 12        |
| 8   | COD-Mn             | mgO <sub>2</sub> /l  | 10            | 20        | 30        |
| 9   | COD-Cr             | mgO <sub>2</sub> /l  | 25            | 70        | 100       |
| 10  | Chlorides          | mgCl/l               | 250           | 300       | 400       |
| 11  | Sulphates          | mgSO <sub>4</sub> /l | 150           | 200       | 250       |
| 12  | Diss.matter        | mg/l                 | 500           | 1000      | 1200      |
| 13  | Total solids       | mg/l                 | 20            | 30        | 50        |
| 14  | Alkalinity         | mg/l                 |               |           |           |
| 15  | Calcium            | mgCa/l               |               |           |           |
| 16  | Magnesium          | mgMg/l               |               |           |           |
| 17  | Sodium             | mgNa/l               | 100           | 120       | 150       |
| 18  | Potassium          | mgK/l                | 10            | 12        | 15        |
| 19  | Ammonia nitrogen   | mgNH <sub>4</sub> /l | 1.0           | 3.0       | 6.0       |
| 20  | Nitrite nitrogen   | mgNO <sub>2</sub> /l | 0.02          | 0.03      | 0.06      |
| 21  | Nitrate nitrogen   | mgNO <sub>3</sub> /l | 5.0           | 7.0       | 15.0      |
| 22  | Kjeldal nitrogen   | mgN/l                |               |           |           |
| 23  | Total nitrogen     | mgN/l                | 5.0           | 10.0      | 15.0      |
| 24  | Orto-phosphate     | mgPO <sub>4</sub> /l | 0.2           | 0.6       | 1.0       |
| 25  | Total phosphate    | mgP/l                | 0.1           | 0.25      | 0.4       |
| 26  | Fe                 | mg/l                 | 1.0           | 1.5       | 2.0       |
| 27  | Mn                 | mg/l                 | 0.1           | 0.3       | 0.8       |
| 28  | Cr                 | mg/l                 |               |           |           |
| 29  | Cd                 | mg/l                 | 0.005         | 0.03      | 0.1       |
| 30  | Cu                 | mg/l                 | 0.05          | 0.05      | 0.05      |
| 31  | Ni                 | mg/l                 | 1.0           | 1.0       | 1.0       |
| 32  | Pb                 | mg/l                 | 0.05          | 0.05      | 0.05      |
| 33  | Phenols            | mg/l                 | 0.005         | 0.02      | 0.05      |
| 34  | Detergents-anionic | mg/l                 | 0.2           | 0.5       | 1.0       |
| 35  | E.coli index       | ml/bact.             | min. 1.0      | min. 0.1  | min. 0.01 |

\* Polish directive no. 116, 503; 5.11.1991

### ANNEX 3: Results of the analysis of the water quality in the river Bystra and its tributaries in 1996

| Analysis of the Bystra river quality - 1996 |      |          |          |         |          |                |                |       |           |             |              |            |                |            |           |          |         |         |      |
|---|------|----------|----------|---------|----------|----------------|----------------|-------|-----------|-------------|--------------|------------|----------------|------------|-----------|----------|---------|---------|------|
| NRP   | LKNL | DATA     | TEMP_PO1 | TEMP_W2 | WODCZYN3 | PRZEWO4        | TLEN_RPR_NAS_5 | BOD56 | CHZT_MN7  | CHZT_CR8    | CHLORKI9     | SIARCZAN10 | SUB_ROZ_ZAW_11 | OCZASAD_12 | WAPN14    | MAGNEZ15 | SOD16   |         |      |
|   |      | Date     | Temp °C  | T. w °C | pH       | Conduct. mS/cm | O2 mg/l        | % sat | BOD5 mg/l | CHZT-M mg/l | CHZT-Cr mg/l | CL mg/l    | SO4 mg/l       | org.d mg/l | alka mg/l | Ca mg/l  | Mg mg/l | Na mg/l |      |
| 1785  | 79   | 08/01/96 | -3.0     | 1.6     | 7.7      | 593            | 12.6           | 90.0  | 2.7       | 2.3         | 18.0         | 24         | 37             | 405        | 9         | 348      | 136.2   | 12.0    | 6.8  |
| 1785  | 79   | 22/04/96 | 21.8     | 14.2    | 8.1      | 651            | 12.9           | 126.0 | 1.2       | 2.7         | 26.0         | 32         | 51             | 471        | 12        | 347      | 136.8   | 13.2    | 9.4  |
| 1785  | 79   | 15/05/96 | 23.8     | 13.7    | 8.2      | 608            | 11.1           | 107.0 | 4.6       | 3.3         | 27.0         | 29         | 38             | 433        | 7         | 338      |         |         |      |
| 1785  | 79   | 20/06/96 | 17.1     | 13.9    | 7.8      | 567            | 10.7           | 104.0 | 3.7       | 2.7         | 13.0         | 26         | 45             | 431        | 15        | 311      | 112.9   | 12.0    | 6.2  |
| 1785  | 79   | 04/07/96 | 22.2     | 14.7    | 8.2      | 568            | 10.2           | 101.0 | 4.7       | 4.0         | 22.0         | 25         | 45             | 552        | 27        | 338      |         |         |      |
| 1787  | 28   | 22/04/96 | 22.5     | 13.1    | 8.2      | 557            | 11.7           | 111.0 | 2.4       | 3.9         | 22.0         | 21         | 41             | 418        | 31        | 324      | 129.3   | 9.8     | 4.4  |
| 1787  | 28   | 15/05/96 | 24.0     | 14.4    | 8.1      | 538            | 8.7            | 87.0  | 3.3       | 7.3         | 29.0         | 20         | 37             | 393        | 20        | 316      |         |         |      |
| 1787  | 28   | 20/06/96 | 17.0     | 12.8    | 7.9      | 528            | 9.6            | 91.0  | 3.0       | 3.9         | 15.0         | 19         | 43             | 413        | 21        | 298      | 108.0   | 11.3    | 4.7  |
| 1787  | 28   | 04/07/96 | 23.6     | 13.0    | 8.2      | 522            | 9.5            | 90.0  | 2.8       | 4.6         | 19.0         | 19         | 40             | 530        | 9         | 331      |         |         |      |
| 1787  | 39   | 08/01/96 | -3.0     | 2.0     | 7.9      | 661            | 12.2           | 86.0  | 2.4       | 3.4         | 23.0         | 16         | 25             | 433        | 7         | 389      | 96.2    | 20.8    | 10.2 |
| 1787  | 39   | 22/04/96 | 22.5     | 11.8    | 8.2      | 566            | 10.3           | 95.0  | 3.3       | 5.4         | 23.0         | 18         | 19             | 419        | 10        | 378      | 113.8   | 17.9    | 8.8  |
| 1787  | 39   | 15/05/96 | 24.0     | 16.5    | 8.1      | 563            | 8.3            | 86.0  | 4.8       | 8.0         | 28.0         | 18         | 18             | 389        | 38        | 384      |         |         |      |
| 1787  | 39   | 20/06/96 | 17.0     | 12.1    | 7.7      | 646            | 8.6            | 80.0  | 4.7       | 2.9         | 12.0         | 22         | 30             | 447        | 8         | 401      | 114.6   | 20.4    | 10.0 |
| 1787  | 39   | 04/07/96 | 25.2     | 15.1    | 8.1      | 589            | 9.3            | 93.0  | 5.2       | 5.4         | 28.0         | 19         | 15             | 459        | 16        | 417      |         |         |      |
| 1787  | 94   | 08/01/96 | -2.2     | 0.8     | 8.0      | 617            | 12.0           | 84.0  | 6.0       | 6.8         | 25.0         | 19         | 32             | 418        | 28        | 436      | 136.5   | 15.7    | 8.6  |
| 1787  | 94   | 22/04/96 | 22.8     | 13.2    | 8.2      | 600            | 12.3           | 117.0 | 4.0       | 6.0         | 32.0         | 22         | 41             | 485        | 17        | 378      | 120.4   | 14.4    | 8.4  |
| 1787  | 94   | 15/05/96 | 23.6     | 16.4    | 8.1      | 560            | 7.5            | 77.0  | 4.9       | 9.0         | 33.0         | 19         | 32             | 405        | 19        | 347      |         |         |      |
| 1787  | 94   | 20/06/96 | 17.2     | 15.0    | 8.1      | 558            | 10.4           | 104.0 | 2.6       | 3.6         | 14.0         | 19         | 35             | 403        | 9         | 342      | 104.4   | 14.0    | 8.4  |
| 1787  | 94   | 04/07/96 | 23.3     | 15.3    | 8.1      | 554            | 11.1           | 111.0 | 3.2       | 3.9         | 20.0         | 20         | 33             | 456        | 11        | 355      |         |         |      |
| 1787  | 168  | 08/01/96 | -2.5     | 3.7     | 8.1      | 483            | 12.6           | 95.0  | 3.4       | 6.0         | 23.0         | 17         | 36             | 323        | 16        | 374      | 114.6   | 12.5    | 4.5  |
| 1787  | 168  | 22/04/96 | 23.0     | 11.2    | 8.3      | 471            | 10.7           | 96.0  | 1.2       | 1.8         | 17.0         | 14         | 34             | 367        | 12        | 326      | 108.7   | 9.4     | 3.7  |
| 1787  | 168  | 15/05/96 | 24.4     | 10.2    | 7.9      | 626            | 6.9            | 62.0  | 2.1       | 1.7         | 20.0         | 15         | 24             | 418        | 18        | 425      |         |         |      |
| 1787  | 168  | 20/06/96 | 17.2     | 9.0     | 8.1      | 558            | 6.6            | 58.0  | 1.6       | 1.1         | 12.0         | 14         | 38             | 442        | 12        | 406      | 109.3   | 22.7    | 6.5  |
| 1787  | 168  | 04/07/96 | 21.0     | 13.6    | 8.2      | 413            | 9.8            | 94.0  | 2.5       | 3.1         | 16.0         | 13         | 31             | 333        | 16        | 256      |         |         |      |
| 1787  | 232  | 08/01/96 | -2.8     | 1.4     | 8.1      | 584            | 13.6           | 96.0  | 4.6       | 2.8         | 23.0         | 16         | 35             | 400        | 10        | 372      | 124.0   | 16.8    | 7.4  |
| 1787  | 232  | 15/01/96 | -5.4     | 1.9     | 8.1      | 605            | 13.4           | 96.0  | 3.6       | 2.9         | 14.0         | 19         | 37             | 461        | 9         | 354      | 101.8   | 13.5    | 9.1  |
| 1787  | 232  | 19/02/96 | 1.6      | 3.3     | 8.0      | 603            | 12.7           | 95.0  | 2.3       | 2.7         | 14.2         | 22         | 28             | 431        | 7         | 350      | 100.8   | 13.7    | 11.5 |
| 1787  | 232  | 01/04/96 | 1.6      | 1.6     | 7.7      | 345            | 10.8           | 77.0  | 11.0      | 38.4        | 37.0         | 13         | 21             | 197        | 44        | 201      | 50.2    | 7.2     | 5.0  |
| 1787  | 232  | 22/04/96 | 23.0     | 13.0    | 8.2      | 560            | 11.4           | 108.0 | 2.1       | 3.6         | 25.0         | 18         | 33             | 395        | 19        | 367      | 119.5   | 14.9    | 5.1  |
| 1787  | 232  | 15/05/96 | 24.3     | 15.9    | 7.5      | 240            | 8.3            | 85.0  | 4.4       | 8.7         | 30.0         | 16         | 30             | 372        | 47        | 319      |         |         |      |
| 1787  | 232  | 20/05/96 | 26.0     | 16.6    | 8.2      | 545            | 9.0            | 93.0  | 2.2       | 7.3         | 38.0         | 19         | 31             | 405        | 17        | 286      | 84.5    | 12.3    | 6.7  |
| 1787  | 232  | 20/06/96 | 17.0     | 13.8    | 8.2      | 544            | 10.1           | 98.0  | 4.5       | 3.5         | 15.0         | 17         | 37             | 434        | 16        | 337      | 108.3   | 16.0    | 7.2  |
| 1787  | 232  | 04/07/96 | 19.6     | 13.7    | 8.2      | 521            | 10.5           | 102.0 | 2.5       | 3.9         | 20.0         | 16         | 32             | 474        | 14        | 360      |         |         |      |



|                 | 18    | 19      | 20        | 21        | 22      | 23      | 24      | 25      | 26      | 27       | 28       | 29     | 30    | 31     | 32    | 33        | 34       | 35         | 36       | 37     |      |
|-----------------|-------|---------|-----------|-----------|---------|---------|---------|---------|---------|----------|----------|--------|-------|--------|-------|-----------|----------|------------|----------|--------|------|
|                 | POTAS | AZ_AMON | AZ_AZOTYN | AZ_AZOTYN | AZ_OG_K | AZ_OGOL | FOSFORA | FOSFORA | FOSFORA | CHROM_OG | CHROM_OG | KADM   | MIEDZ | NIKIEL | LOW   | FENOLE_LO | DET_ANIO | M_COI_KAL  | ST_SAP_S | SAPROB |      |
|                 | K     | N-NH4   | N-NO2     | N-NO3     | N-Kje   | N-tot   | PO4     | P-tot   | Fe-to   | Mn       | Cr-tot   | Cd     | Cu    | Ni     | Pb    | Phenol    | Det-a    | Coil bact. |          | Sapro  |      |
|                 | mg/l  | mg/l    | mg/l      | mg/l      | mg/l    | mg/l    | mg/l    | mg/l    | mg/l    | mg/l     | mg/l     | mg/l   | mg/l  | mg/l   | mg/l  | mg/l      | mg/l     | mg/l       | mg/l     | mg/l   | mg/l |
| Bystra 25.5 km  | 6.7   | 0.15    | 0.010     | 2.68      | 0.97    | 3.65    | 0.35    | 0.16    | 0.05    | 0.11     |          |        |       |        |       | 0.000     | 0.00     | 0.2        | 2.09     | 2.09   |      |
| river Czerka    | 7.0   | 0.60    | 0.020     | 3.93      | 1.51    | 5.46    | 0.38    | 0.29    | 0.33    | 0.14     |          |        |       |        |       | 0.000     | 0.01     | 0.2        | 2.12     | 2.12   |      |
|                 |       | 0.59    | 0.040     | 3.55      | 1.30    | 4.89    | 0.60    | 0.35    | 0.16    | 0.11     |          |        |       |        |       | 0.000     | 0.01     | 0.0        | 2.43     | 2.43   |      |
|                 | 2.9   | 0.20    | 0.030     | 3.03      | 1.32    | 4.38    | 0.35    | 0.15    | 0.23    | 0.13     | 0.000    | 0.0000 | 0.000 | 0.001  | 0.000 | 0.000     | 0.00     | 0.2        | 2.06     | 2.06   |      |
| (P-2)/B-I       |       | 0.49    | 0.040     | 4.90      | 1.58    | 6.52    | 0.47    | 0.41    | 0.56    | 0.14     |          |        |       |        |       | 0.000     | 0.00     | 0.0        | 2.22     | 2.22   |      |
| Bystra 22.6 km  | 3.4   | 0.49    | 0.010     | 1.42      | 1.52    | 2.95    | 0.02    | 0.22    | 0.23    | 0.04     |          |        |       |        |       | 0.000     | 0.01     | 0.1        | 2.36     | 2.36   |      |
| Naleczów town   |       | 0.78    | 0.040     | 1.30      | 1.67    | 3.01    | 0.45    | 0.30    | 0.21    | 0.03     |          |        |       |        |       | 0.000     | 0.01     | 0.0        | 2.13     | 2.13   |      |
| (P-4)/B-II      | 1.7   | 0.17    | 0.030     | 1.04      | 1.45    | 2.52    | 0.35    | 0.17    | 0.21    | 0.04     | 0.000    | 0.0000 | 0.000 | 0.002  | 0.000 | 0.000     | 0.01     | 0.0        | 2.12     | 2.12   |      |
|                 |       | 0.44    | 0.020     | 1.80      | 1.59    | 3.41    | 0.38    | 0.21    | 0.33    | 0.06     |          |        |       |        |       | 0.000     | 0.00     | 0.1        | 1.91     | 1.91   |      |
| Bystra 21.5 km  | 4.0   | 0.52    | 0.010     | 0.88      | 1.38    | 2.27    | 0.14    | 0.09    | 0.56    | 0.23     |          |        |       |        |       | 0.000     | 0.02     | 0.4        | 1.90     | 1.90   |      |
| r. Bochniczank  | 3.6   | 0.44    | 0.020     | 0.91      | 1.56    | 2.49    | 0.04    | 0.19    | 0.54    | 0.04     |          |        |       |        |       | 0.000     | 0.02     | 0.4        | 1.95     | 1.95   |      |
|                 |       | 0.27    | 0.020     | 0.20      | 0.79    | 1.01    | 0.20    | 0.13    | 0.50    | 0.04     |          |        |       |        |       | 0.000     | 0.02     | 0.0        | 2.07     | 2.07   |      |
| (P-6)/B-III     | 2.5   | 0.20    | 0.010     | 1.73      | 1.55    | 3.29    | 0.19    | 0.10    | 0.34    | 0.07     | 0.000    | 0.0000 | 0.000 | 0.001  | 0.000 | 0.000     | 0.01     | 0.2        | 1.91     | 1.91   |      |
|                 |       | 0.46    | 0.010     | 4.00      | 1.76    | 5.77    | 0.12    | 0.07    | 0.50    | 0.09     |          |        |       |        |       | 0.000     | 0.01     | 0.4        | 1.67     | 1.67   |      |
| Bystra 16 km    | 4.8   | 0.98    | 0.040     | 1.37      | 1.60    | 3.36    | 0.48    | 0.17    | 0.39    | 0.15     |          |        |       |        |       | 0.000     | 0.03     | 0.0        | 2.27     | 2.27   |      |
| Wawolnica town  | 4.7   | 1.55    | 0.030     | 1.55      | 2.76    | 4.34    | 0.23    | 0.16    | 0.52    | 0.77     |          |        |       |        |       | 0.000     | 0.02     | 0.0        | 2.17     | 2.17   |      |
|                 |       | 0.42    | 0.070     | 1.40      | 1.03    | 2.50    | 0.74    | 0.48    | 0.59    | 0.12     |          |        |       |        |       | 0.000     | 0.01     | 1.7        | 1.97     | 1.97   |      |
| (P-7)/B-IV      | 1.8   | 0.30    | 0.080     | 1.40      | 1.72    | 3.20    | 0.65    | 0.26    | 0.21    | 0.05     | 0.000    | 0.0000 | 0.000 | 0.000  | 0.001 | 0.000     | 0.00     | 0.0        | 1.91     | 1.91   |      |
|                 |       | 0.64    | 0.060     | 2.10      | 2.11    | 4.27    | 0.72    | 0.40    | 0.27    | 0.06     |          |        |       |        |       | 0.000     | 0.00     | 0.0        | 2.12     | 2.12   |      |
| Bystra 8.6 km   | 3.2   | 0.15    | 0.010     | 2.11      | 0.93    | 3.05    | 0.18    | 0.14    | 0.17    | 0.10     |          |        |       |        |       | 0.000     | 0.00     | 0.4        | 2.10     | 2.10   |      |
| stream Witoszyn | 1.6   | 0.66    | 0.010     | 2.02      | 1.55    | 3.58    | 0.04    | 0.11    | 0.47    | 0.13     |          |        |       |        |       | 0.000     | 0.01     | 0.8        | 2.23     | 2.23   |      |
|                 |       | 0.68    | 0.000     | 1.31      | 1.52    | 2.83    | 0.14    | 0.09    | 0.03    | 0.04     |          |        |       |        |       | 0.000     | 0.00     | 0.0        | 1.68     | 1.68   |      |
| (P-8)/B-V       | 1.2   | 0.03    | 0.000     | 1.22      | 0.03    | 1.25    | 0.16    | 0.10    | 0.03    | 0.02     | 0.000    | 0.0000 | 0.001 | 0.001  | 0.000 | 0.000     | 0.01     | 0.8        | 1.69     | 1.69   |      |
|                 |       | 0.50    | 0.010     | 2.02      | 0.88    | 2.91    | 0.10    | 0.05    | 0.20    | 0.02     |          |        |       |        |       | 0.000     | 0.00     | 0.2        | 1.99     | 1.99   |      |
| Bystra 2.2 km   | 4.9   | 0.44    | 0.010     | 1.15      | 1.36    | 2.52    | 0.36    | 0.19    | 0.17    | 0.12     |          |        |       |        |       | 0.000     | 0.03     | 0.5        | 1.95     | 1.95   |      |
| Bochnica town   | 2.4   | 0.56    | 0.010     | 1.24      | 1.34    | 2.59    | 0.40    | 0.19    | 0.20    | 0.10     | 0.000    | 0.0000 | 0.000 | 0.000  | 0.001 | 0.000     | 0.04     | 0.0        | 2.34     | 2.34   |      |
|                 | 2.9   | 0.50    | 0.010     | 1.23      | 1.32    | 2.56    | 0.41    | 0.17    | 0.24    | 0.05     | 0.000    | 0.0000 | 0.000 | 0.000  | 0.000 | 0.000     | 0.02     | 0.2        | 2.15     | 2.15   |      |
| (P-11)/B-VI     | 6.7   | 2.47    | 0.040     | 1.49      | 4.30    | 5.83    | 0.55    | 0.28    | 5.50    | 0.43     | 0.000    | 0.0000 | 0.002 | 0.000  | 0.001 | 0.000     | 0.03     | 0.4        | 2.18     | 2.18   |      |
|                 | 3.2   | 0.54    | 0.020     | 1.25      | 1.78    | 3.05    | 0.06    | 0.41    | 0.30    | 0.05     |          |        |       |        |       | 0.000     | 0.03     | 0.4        | 2.06     | 2.06   |      |
|                 |       | 0.55    | 0.050     | 0.90      | 1.34    | 2.29    | 0.52    | 0.25    | 0.43    | 0.04     |          |        |       |        |       | 0.000     | 0.02     | 0.0        | 2.11     | 2.11   |      |
|                 | 2.1   | 0.55    | 0.070     | 1.30      | 1.47    | 2.84    | 0.51    | 0.19    | 0.31    | 0.03     | 0.001    | 0.0000 | 0.001 | 0.002  | 0.000 | 0.000     | 0.02     | 0.2        | 1.90     | 1.90   |      |
|                 | 1.7   | 0.38    | 0.020     | 1.14      | 1.54    | 2.70    | 0.34    | 0.14    | 0.21    | 0.05     | 0.000    | 0.0000 | 0.000 | 0.002  | 0.000 | 0.000     | 0.00     | 0.0        | 1.99     | 1.99   |      |
|                 |       | 0.40    | 0.010     | 1.30      | 1.62    | 2.93    | 0.50    | 0.22    | 0.32    | 0.06     |          |        |       |        |       | 0.000     | 0.01     | 0.0        | 1.97     | 1.97   |      |

## ANNEX 4: Characteristic flows for the Bystra river at different profiles (1950-1970)

| River                              | Flow rate  |              |                    |                   |                   |                   |                   |                   |                   |
|------------------------------------|------------|--------------|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|                                    | Profile    |              |                    | Q low average     | Longest-year      | Longest-vegetat.  | Q-average year    | Q-average vegetat | Q large average   |
|                                    | No         | Km of length | A, km <sup>2</sup> | m <sup>3</sup> /s | m <sup>3</sup> /s | m <sup>3</sup> /s | m <sup>3</sup> /s | m <sup>3</sup> /s | m <sup>3</sup> /s |
| Bystra ,before Czerka's outlet     | P-1        | 34           | 33,2               | 0,08              | 0,11              | 0,11              | 0,16              | 0,16              | 1,41              |
| outlet Czerka                      | P-2/ B-1   | 25,5         | 47,3               | 0,11              | 0,14              | 0,14              | 0,19              | 0,20              | 1,62              |
| Bystra, below Czerka outlet        | P-3        |              | 35,5               | 0,21              | 0,27              | 0,27              | 0,35              | 0,36              | 2,41              |
| Bystra, Naleczów profile reservoir | P-4/ B-II  | 22,6         | 100,6              | 0,25              | 0,33              | 0,33              | 0,41              | 0,43              | 2,67              |
| Bochotniczanka, profile reservoir  | P-5        |              | 22,6               | 0,05              | 0,06              | 0,06              | 0,09              | 0,10              | 0,99              |
| outlet Bochotniczanka              | P-6/ B-III | 21,6         | 29,6               | 0,06              | 0,09              | 0,09              | 0,12              | 0,13              | 1,19              |
| Bystra, Wawolnica bridge           | P-7/ B-IV  | 16           | 149,1              | 0,38              | 0,50              | 0,50              | 0,61              | 0,64              | 3,49              |
| outlet-Dopływ spod Witoszyna       | P-8/ B-V   | 8,6          | 39,6               | 0,09              | 0,12              | 0,12              | 0,16              | 0,17              | 1,44              |
| Bystra, profile reservoir          | P-9        |              | 264,3              | 0,71              | 0,91              | 0,91              | 1,08              | 1,13              | 5,12              |
| Bystra, measure point-Wierzchoniów | P-10       |              | 281,6              | 0,76              | 0,98              | 0,98              | 1,15              | 1,20              | 5,34              |
| outlet Bystra                      | P-11/ B-VI | 2,2          | 295,7              | 0,80              | 1,03              | 1,03              | 1,21              | 1,26              | 5,52              |

## ANNEX 5: Characteristic of the agricultural activities within the Bystra catchment area

| Parameters                      | Wojciechów       |                 | Naleczów         | Wawolnica         |               | Kaz. Dlny        | Total    |
|---------------------------------|------------------|-----------------|------------------|-------------------|---------------|------------------|----------|
|                                 | individual farms | (działki rolne) | individual farms | individual farms. | działki rolne | individual farms |          |
| Total area (ha)                 | 7396,51          | 149,95          | 4706,45          | 4776,68           | 122           | 2357             | 19508,59 |
| Agriculture areas (ha)          | 6733,31          | 114,59          | 4179,41          | 4029,52           | 87,14         | 1781             | 16924,97 |
| - arable                        | 6368,56          | 97,23           | 3409,62          | 3402,47           | 73,05         | -                | 13350,93 |
| - orchard                       | 207,98           | 10,1            | 428,11           | 270,14            | 5,52          | -                | 921,85   |
| Seed-corn (ha)                  | 6338,39          | 90,35           | 3335,62          | 3270,28           | 69,51         | 1383             | 14487,15 |
| - wheat                         | 1595,99          | -               | 875,61           | 591,67            | -             | 191              |          |
| - mixed corn                    | 1320,32          | -               | 708,58           | 995,78            | -             | 407              |          |
| - potato                        | 1258,65          | 47              | 424,25           | 460,73            | 22,14         | 238              |          |
| Animal breeding                 |                  |                 |                  |                   |               |                  |          |
| - cattle (st)                   | 2681             | 26              | 1658             | 1473              | 14            | 683              | 6535     |
| - pigs (st)                     | 10072            | 41              | 1973             | 2542              | 13            | 1018             | 15659    |
| - sheep (st)                    | 72               | 3               | 56               | 162               | -             | -                | 293      |
| Number of persons at farm total | 5216             | 547             | 4165             | 3285              | 735           | 2184             | 16132    |
| - working only at farm          | 2408             | 178             | 1751             | 1483              | 219           | -                | 6039     |

## ANNEX 6: Characteristic of the main communes in the Bystra river catchment area

| Commune   | Wojciechów | Naleczów | Wawolnica | Kazimierz Dolny | Total |
|---|------------|----------|-----------|-----------------|-------|
| Total area of commune, km <sup>2</sup>              | 80,9       | 62,8     | 62,2      | 72,5            | 278,4 |
| Within Bystra catch., km <sup>2</sup>               | 74,4       | 47,1     | 60,5      | 34,3            | 216,3 |
| %   | 92,0       | 75,0     | 97,3      | 47,3            | 77,7  |
| Use of the area, %                                  |            |          |           |                 |       |
| * Agricultural areas                                | 88,2       | 82,0     | 80,9      | 62,1            |       |
| * Forestry and forest area                          | 5,5        | 6,8      | 9,8       | 12,0            |       |
| * Living area                                       | 3,5        | 5,5      | 2,5       | 3,3             |       |
| * Other   | 2,7        | 5,7      | 6,8       | 22,6            |       |
| Population  |            |          |           |                 |       |
| * Total in 1995                                     | 6172       | 9542     | 5185      | 7321            | 28220 |
| * Planned 2000                                      | 6350       | 12300    | 11000     | 7700            | 37350 |
| ** In a community 1995                              | 1534       | 4287     | 1675      | 2271            | 9767  |
| ** Planned 2000                                     | 1550       | 5700     | 6000      | 4200            | 17450 |
| Number of : towns                                   | 0          | 1        | 0         | 1               | 2     |
| villages  | 20         | 12       | 16        | 15              | 63    |
| Water supply systems                                |            |          |           |                 |       |
| * Central (municipal)                               | -          | -        | -         | -               |       |
| * Group   | -          | +        | +         | +               |       |
| * Local   | +          | +        | -         | -               |       |
| * Individual  | +          | +        | -         | +               |       |
| Connected to municipal water supply system, %, 1995 | 0,6        | 86,0     | 82,7      | 53,9            |       |
| Number of waste water treatment plants:             |            |          |           |                 |       |
| * municipal   | -          | 1        | -         | 1               | 2     |
| * local   | -          | -        | 2         | -               | 2     |
| * industry  | 1          | 2        | 1         | -               | 4     |

## ANNEX 7: Main meetings/seminars held

| Nr. | Activity   | Period                       | Participants   | Agreement/<br>Summary |
|-----|--|------------------------------|--|-----------------------|
| 1.  | January 1996 project meeting in Warsaw   | January/<br>February<br>1996 | Representatives of IOS<br>Representatives of NIVA (GAA,<br>SSJ)  | Annex 7.1             |
| 2.  | May 1996 project meeting in Warsaw combined with a visit of the catchment area | May 1996                     | Representatives of IOS<br>Representatives of NIVA (GEN)  |                       |
| 3.  | July 1996 project meeting in Naleczów  | July 1996                    | Representatives of IOS<br>Representatives of NIVA (GAA,<br>GEN, SAB)<br>Representatives of the communes                                | Annex 7.2             |
| 4.  | Seminar for presentation of the results of Phase I                             | January<br>1997              | Representatives of IOS<br>Representatives of NIVA (GEN)<br>Representatives of the communes<br>Representatives of the Steering<br>Group | Annex 7.3             |

GAA: Gunnar Aasgaard  
 GEN: Grazyna Englund  
 SAB: Stig A. Borgvang  
 SSJ: Svein Stene-Johansen

### List of publications/notes:

- B. Osmulka-Mróż *et al.* "Strategy for Integrated Water Supply, Wastewater Treatment and Disposal Systems in Bystra River Catchment Area in Poland - Gathering of data, (in Polish), IR
- B. Osmulka-Mróż *et al.* "Programme of sanitation and water protection in Bystra River Catchment Area in Poland - (Master and Action Plans for the Bystra catchment) - Pollution statement, in Polish, IR
- G. Englund, " Minutes of the meeting in Poland in July 1996", WP
- G.Fr. Aasgaard, " Minutes from the seminar January 21, 1997", WP

Interim Report (IR), Working paper(WP), Technical, Paper(TP), Research Paper(RP)

**ANNEX 7.1:**

**Project agreement at the January 1996 Project Meeting**

**Letter of Intent**

for co-operation in the project

**Strategy for Integrated Water Supply, Wastewater Treatment and Disposal Systems in Small Communities in Poland**

The presidents of the communes Wojciechów, Nałęczów, Wąwolnica and Kazimierz Dolny are very much interested in preparing Master and Action Plan (M&AP) for the catchment area of Bystra River. These activities will be the main activity in the above mentioned project, as proposed by the Norwegian Institute for Water Research (NIVA), Norway and Institute of Environmental Protection (IOS), Poland. We declare assistance during the work on the project. We also want NIVA and IOS to assist our consultant engineers in their engineering of the proposed, prioritised actions, in our preparing of the tendering documents and in follow up activities in the implementing phase of the project.

Last year the four communes established the Union for River Bystra Protection and making a M&AP is an important first step towards a better environment in our region. We will of course implement the results of this M&AP as soon as funding is available.

NIVA and IOS will co-operate in making the M&AP for the catchment area of Bystra River as soon as funding is available. The two institutes will also, based on the methodology used in the project, make a draft for Polish Guidelines for making such plans.

The National Fund for Environmental Protection and Water Management (NFEP) will consider the proposed actions in the above mentioned M&AP to be part of our priorities in 1996-1998 as soon as we get to know the results and recommendations of the M&AP and we agree with its content & expertise. When it is done we will launch the implementation procedures related to financing of the project following the National Fund principles and regulations.

This document is signed in seven copies, one for each party.

Nałęczów, 9 February 1996

|  |  |  |                             |
|--|--|--|-----------------------------|
| On behalf of the communes<br>Wojciechów, Nałęczów,<br>Wąwolnica and<br>Kazimierz Dolny | On behalf of IOS   | On behalf of NIVA  | On behalf of NFEP           |
| <b>ZARZĄD GMINY<br/>NAŁĘCZÓW</b><br>inż. Stanisław Bednarczyk Burmistrz                | <b>NORWEGIAN INSTITUTE FOR WATER RESEARCH</b><br>P. O. Box 173 Kjelsås<br>0411 Oslo Norway |  | Zastępca Prezesa Zarządu    |
| <b>ZARZĄD GMINY<br/>Wąwolnica</b><br>Drżula Barkowicz Sekretarz                        | <b>DIREKTOR INSTYTUTU</b><br>inż. Paweł Błyszczak  | Gunnar Fr. Aasgaard<br>Head of Research Dept.,<br>Environmental Techn. | dr hab. Wojciech Białkowski |
| <b>WÓJT GMINY</b><br>inż. Marcin Zaba  | <b>ZARZĄD MIASTA<br/>Kazimierz Dolny</b>   |  |                             |

## ANNEX 7.2 Minutes from the July 1996 Project Meeting

### Participation

In accordance with the project programme, the second project meeting was held 8- 11 July 1996 in Poland with representatives from IOS and NIVA:

IOS:

- Prof. Barbara Osmulska-Mròz - Polish project leader
- Ph.D. Eng. Pawel Blaszczyk - director of IOS
- Ph.D. Maria Fidala-Szope - water & wastewater expert
- Ph.D. Jan Borzyszkowski - hydrogeologist

NIVA:

- M.Sc. Gunnar Aasgaard - Norwegian project leader
- M.Sc. Grazyna Englund - environmental engineer
- M.Sc. Stig A. Borgvang - limnologist, water resource management.

The representatives of the 4 communities in the river Bystra catchment were as follows:

- Naleczów town hall: village mayor Mr Wojciech Wójcik
- Wojciechów local authority: village mayor Mr Stanislaw Bendkarski, and representatives of the Local Authority Council Mr Edward Matras and Ms Krystyna Wagorowska (agriculture & irrigation)
- Wawolnica local authority: village mayor Mr Marian Zaba
- Kazimierz Dolny: village mayor Mr Andrzej Szczypa, vice-mayor Mr Ignacy Wlodek.

The programme of the meeting is at Appendix 1

### Topics

Appendix 2 gives an overview of the subjects discussed at IOS. The following questions were, *inter alia*, raised:

- How are EC-guidelines/regulations implemented at local level?
- How are national/regional laws implemented and enforced ?

Every "local meeting" comprised an introduction made by the local authorities, an overview of the current "project situation" as well as a discussion on how to take the project further i.e. future plans for important environmental issues.

NIVA considered it important to, *inter alia*, ask the local authorities about:

- What connection they see between this project and their future plans?
- What do they expect from the project?
- What is the current situation today with regard to:
  - water supply
  - sewerage and treatment
  - main sources of pollution (agriculture, household, industry, recreation.)
  - waste policy
  - budget and funding?
- Future environmental and physical planning?
- User interest related to the Bystra river?

## Most important observations and comments

A table summarising the information gathered with regard to population, user interests, water supply and treatment is at Appendix 3.

## Main Conclusions

1. The project progresses according to the programme although it should be noted that the financial support for the project for both sides was considerably delayed.
2. The Polish partner will prepare a first part data report with all the data gathered to date will be presented (in Polish)
3. Both sides will work on proposals for alternative abatement strategies for the Bystra river catchment. After discussions between IOS and NIVA, the results of the project activities and the alternative solutions will be presented to and discussed with the representatives of all the involved communities (and the National Fond for Environmental Protection and Water Management in Poland and SFT in Norway ) at a seminar planned to be held by the end of 1997 or at the beginning of 1998.
4. Some information is lacking. Further support will be necessary for running for example the sampling and analytical programme in the Bystra river.
5. Some extra financial support is needed for translating documents/reports from Polish to English/Norwegian.



## APPENDIX 1: Programme

| Day | Date                  | Activities  | Participants  |
|-----|-----------------------|---|---|
| 1   | Monday<br>08.07.96    | <ul style="list-style-type: none"> <li>• Presentation of the project progress</li> <li>• Discussions on the gathered data</li> <li>• Outstanding information</li> <li>• Discussions of the programme of the field trip</li> <li>• Tour to Naleczów</li> </ul>   | IOS and NIVA  |
| 2   | Tuesday<br>09.07.96   | <ul style="list-style-type: none"> <li>• Visit of the Naleczów town hall</li> <li>• Visiting the Czeslawice sewage treatment plant (Agriculture Research Station)</li> <li>• Visit of the Wawolnica local authority</li> <li>• Visit of the canyons in Rablin and water sources</li> <li>• Visit of Biovac plant for school</li> <li>• Field trip along the Bochotniczka stream and part of the Bystra river</li> </ul> | <p>Ms Urszula Borkowska</p> <p>Mr Michal Bentkowski, manager<br/>IOS and NIVA and village mayor Mr Marian Zaba</p> <p>IOS and NIVA and Mr Marian Zaba</p>   |
| 3   | Wednesday<br>10.07.96 | <ul style="list-style-type: none"> <li>• Visit of the Naleczów town hall</li> <li>• Visit of Kazimierz Dolny</li> <li>• Visit of the sewage treatment plant in Bochotnica</li> <li>• Visit of Wojciechów, "agro-tourism"</li> </ul>   | <p>IOS and NIVA and village mayor Mr Wojciech Wójcik</p> <p>IOS and NIVA, village mayor Mr Andrzej Szczypa and vice-mayor Mr Ignacy Wlodek</p> <p>IOS and NIVA and the director of the Culture House, Mr Wieslaw Czerniec</p> |
| 4   | Thursday<br>11.07.96  | <ul style="list-style-type: none"> <li>• Visit of the Wojciechów local authority</li> <li>• Summary of the project meeting</li> <li>• Revision of the future activities plan</li> <li>• Near future agreements</li> </ul>   | <p>IOS and NIVA, village mayor Mr Stanislaw Bendkarski, representatives of the Local Authorities Council Mr Edward Matras and Ms Krystyna Wagorowska, (agriculture &amp; irrigation)</p> <p>IOS + NIVA</p>                    |

## APPENDIX 2: Topics

| <b>Geographical data</b>   | <b>Information about pollution</b>   | <b>Water supply</b>  |
|--|--|--|
| <ul style="list-style-type: none"> <li>- Length of the Bystra river</li> <li>- Area of the catchment</li> <br/> <li>- Maps: topography</li> <li>- Existing plans for area use, sewerage system, treatment plants</li> <li>- Cities, number of inhabitants</li> <br/> <li>- Villages, inhabitants</li> <li>- Maps of sewerage system, water network, ww plants..</li> <li>Hydrological/ geological data</li> <br/> <li>- Classes of river(s)</li> <li>- Precipitation - quality<br/>- quantity</li> <li>- Hydrological map</li> <li>- Geological map</li> <li>- Water resources</li> <br/> <li>- Satellite photos</li> <li>- Measurements in rivers and ground water basins</li> <br/> <li><b>User interests</b></li> <li>- Drinking water</li> <li>- Bathing water</li> <li>- Recreation</li> <br/> <li><b>Monitoring programme:</b></li> <li>- Stations</li> <li>- Analyses</li> <li>- Frequency</li> <li>Standards/ regulations/ legislation</li> <li>- Laws and regulations</li> <li>- For water resources</li> <li>- For the factories and institutions</li> <li>- For the existing waste water treatment plants</li> <li>- For the recipient</li> </ul> | <ul style="list-style-type: none"> <li>- <b>From Agriculture:</b></li> <li>- manure (quantity, application, time: crops, areas)</li> <li>- artificial fertilisers ( " " ")</li> <li>- pesticides: substances, quantities applied, period of application</li> <li>- herbicides: substances, quantities applied, period of application</li> <br/> <li>- <b>From industry:</b></li> <li>- mineral water industry (load, parameters, processes)</li> <li>-</li> <li>- <b>From institutions:</b></li> <li>- water consumption</li> <li>- waste water production (flow, quality)</li> <li>-</li> <br/> <li>- <b>From recreation:</b></li> <li>bathing</li> <br/> <li>- <b>From tourism:</b></li> <li>- number of tourists</li> <li>- <b>From fishing:</b></li> <br/> <li><b>From forestry:</b> -</li> <li>-</li> </ul> | <ul style="list-style-type: none"> <li>- sources of supply</li> <li>- municipal connection/no of p.e.</li> <br/> <li>- individual connection / wells</li> <li>- water consumption (measured, estimated, calculated)</li> <br/> <li>Pollution/ Waste water treatment</li> <li>- point pollution sources, from agriculture,....</li> <li>- treatment plants, all relevant data (pollution load, effluent quality...), p.e. connected..</li> <li>- spread, individual (septic tank)</li> <li>- waste water production rate</li> <br/> <li>Financing and recovery</li> <li>- Maintenance costs for existing waterworks</li> <li>- " " " wastewater treatment plants</li> <li>- " " " for sewerage systems</li> <li>- Recovery costs; taxes for inhabitants, institutions and industry</li> <li>- Metering systems, cost per m<sup>3</sup></li> <br/> <li>Methodology and analyses</li> <li>- Phosphorus</li> <li>- Biological observation; heterotrophic growth, algal blooms, vertebrates, ....</li> <li>- Coliform bacteria/ E-coli</li> <li>- Turbidity, ss, pH, alkalinity, hardness</li> <li>- COD /BOD/ TOC</li> <li>- Fe, Mn</li> <li>- Heavy metals</li> </ul> |
| <ul style="list-style-type: none"> <li>- Other information relevant to the project</li> </ul>  |  |  |

The questionnaires should provide an overview of :

- existing information
- plans for future information collection
- information gathered through regional/national monitoring plans
- information available in English/Polish
- responsible for information collection
- deadlines

| Communities               | Population in 1995 | River-Groundwater                                      | User interests                 | Objectives set by the communities  | Remarks  | Potential sources of pollution   | Proposed measures                                    |
|---------------------------|--------------------|--|--------------------------------|--|--|--|--|
| Miasto/Gmina              |                    | Rzeka- woda gruntowa                                   | Użytkownicy                    |  | Komentarze   | Potencjalne źródła zanieczyszczeń  | Proponowane rozwiązania                              |
|                           |                    |  |                                |  | Nutrients, organic matter, micropollutants, particles, fecal bacteria, algae, background concentrations / load |  |  |
| 1. <b>Wojciechów</b>      |                    | Bystra   | Agriculture                    | Individual water supply - wells  | - Septic tanks pollution   | - Septic tanks   | - Planned water supply system                        |
| Totally                   | 6172               | Czerka (P-2, 0.2km, 47.3 km <sup>2</sup> )             | Agro-tourisme "green lung"     |  | - Waste is transported outside the community   |  | - Would like to construct a model (pilot) waste site |
|                           |                    |  | Fishing (new reservoir)        |  |  |  | - Planned to build a new reservoir                   |
| 2. <b>Naleczów (town)</b> | 4287               | Bystra (P-4, 22.6km, 100.6 km <sup>2</sup> )           | Agriculture<br>Recreation      | Town - 100% water supply and sewerage <i>max. 60%-transported to the WWTP in Naleczów, the remaining need pump-stations.</i> | - Long range transported air pollution (N, S)  | - 3 WWTPs, point source discharges to the river Bystra                                       | - Upgrading of WWTP functioning                      |
|                           |                    | Bochońniczanka (P-6, 0.1 km, 29.6 km <sup>2</sup> )    | Light industry (mineral water) | Villages - all have water supply, sewerage system - individual (septic tanks)  | - Fine sand pollution from transport activities  | - Agricultural/ small parcels / fertilising/ eutrophication (expect answer from the project) | - Locating waste disposal site + road                |
| Villages                  | 5255               |  |                                |  |  |  | - Pre-treatment of run-off water                     |
| City & Villages           | 9542               |  |                                | Recreation and Health center:<br>- Nature element + recreation<br>- Increase fishing and bathing possibilities               |  |  | - Improved agriculture management                    |
| Sanatorium                | 1241               |  |                                |  |  |  | - Renovation of lake at sanatorium                   |
| 3. <b>Wawolnica</b>       |                    | Bystra (Wawolnica, P-7, 16 km, 149.1 km <sup>2</sup> ) | Recreation (new reservoir)     | 81% water supply, no sewerage system, only ind. septic tanks. Generally "polluted"   | 100% water supply within 2 years   | Agriculture: erosion, fertilising (about. 60 kg/ha)  | - Protect the loess-soil wash out by growth-barriers |
| Total                     | 5381               |  | Fishing                        | More environmental friendly agriculture by:  |  | Industry: fruit processing (Materna), meat processing  |  |

| Communities               | Popula-<br>tion in<br>1995 | River-<br>Groundwater  | User interests                                      | Objectives set by the communities  | Remarks  | Potential sources of<br>pollution  | Proposed measures   |
|---------------------------|----------------------------|--|---|--|--|--|---|
|                           |                            |  | Bathing<br>Irrigation                               | <ul style="list-style-type: none"> <li>- Regroupment of parcels in order to reduce erosion</li> <li>- Decrease the proportion of agriculture land of the total surface by increasing the proportion of forest</li> <li>- Mustard and lupin seeds to be planted and subsequently ploughed in order to provide additional nitrogen to the soil (N-fixation)</li> </ul> | Private wells may be contaminated by the effluent from septic tanks  | Households/<br>institutions: sewage<br><br>Precipitation:<br>erosion                                   |   |
|                           |                            |  |   | <ul style="list-style-type: none"> <li>Industry: - Find a new site for the meat processing plant</li> </ul>  |  | Pig and poultry farms  |   |
|                           |                            |  |   | <b>Recreation and Health center:</b> <ul style="list-style-type: none"> <li>- Creation of an artificial lake</li> <li>- Raise the groundwater level, reduce the peak flow in the river</li> <li>- Increase fishing and bathing possibilities</li> <li>- Construction of a sanatorium</li> </ul>  |  |  |   |
|                           |                            |  |   | <b>Waste disposal:</b> - Establishment of a waste disposal site<br><b>Water supply:</b> establishment of a new water work to provide water for 19% of the population ( to be completed by the year 2000 )  |  | Septic tanks<br>Agricultural activities  |   |
|                           |                            | Groundwater  | Drinking water                                      |  |  |  |   |
| <b>4. Kazimierz Dolny</b> |                            | <b>Bystra (33,4 km)</b><br>(catchment area:<br>295.7 km <sup>2</sup> , P-11) | Agriculture<br>Tourisme<br>Nature<br>reconstruction | Villages - some villages 80-90% water supply, groundwater, no sewerage system (plans- 50 pump stations)<br>Canyons (V-shaped) - erosion  | - Difficult terrain (canyons)<br>- Waste is transported outside the catchment<br>- Each place has containers for waste | - 1 WWTP<br>Agriculture (intensive horti-culture+vegetables)<br>-Erosion on the slopes<br>-N+P run off | - Use of the territory for eco-tourism purposes<br>- Nature reconstruction, reservoir, increase the forest proportion<br>- Improve the sanitation situation<br>- Reconstruction of wet-land |
| - <u>Bohotnica</u>        | 1070                       |  |   |  |  |  |   |
| - Rzezzyca Kol.           | 242                        | spod Witoszyna   |   |  |  |  |   |
| - Skowieszynek            | 47                         | (P-8, 8.6 km, 39.6 km <sup>2</sup> )   |   |  |  |  |   |
| - Witoszyn                | 241                        | (Bohotnica, P-11, 2.2 km)  |   |  |  |  |   |
| - Wierzhoniów             | 286                        |  |   |  |  |  |   |
| - Zbedowice               | 245                        |  |   |  |  |  |   |
| Total villages:           | 2131                       |  |   |  |  |  |   |

## ANNEX 7.3:

### Report of the Project Meeting 21. January 1997

#### Introduction

The seminar on Tuesday 21 January 1997 in Naleczów was organised in order to present and discuss the results of phase 1 of the project "Strategy for Integrated Water Supply, Wastewater Treatment and Disposal Systems in Small Communities in Poland". It was an important element in the transfer of competence and was attended by politicians in the pilot communities, representatives of neighbour communities, regional environmental authorities and the Steering Committee of the project (in total 26 participants). The seminar was chaired by the chairman of the Steering Committee, Professor Krzysztof Wierzbicki.

#### General

The data collected were presented by the Polish Project leader, Professor Barbara Osmulsk-Mroz, Institute of Environmental Protection (IOS) and the Norwegian Project leader, Ms Grazyna Englund, NIVA. The following comments were, *inter alia*, given:

- there are great expectations as to the outcome of the project;
- the scope of the project should have been broader geographically, inclusion of neighbour communities in adjacent water courses, and with regard to the topics included, such as monitoring of ground water, waste disposal and GIS based presentation.

The Polish representatives of the local authorities expressed their appreciation for the considerable amount of work done so far within the project and were looking forward to the results of the Phase-2 activities.

It was pointed out that it was particularly important to achieve good results from the current project, as it is planned to become a demonstration project which will be used as an example for other communities to perform similar Master and Action Plans. Such activities may also provide additional opportunities for Norwegian technology in Poland.

#### Summary

The main objective of Phase I of the project has been to assess the need measures and to provide the necessary data in order to prioritise the measures by:

- identifying user interests of the water resources;
- mapping the water quality in the water bodies;
- localising and quantifying the sources of pollution;
- mapping existing wastewater treatment plants.

## Results of the Phase I of the project

### *User interests*

The following points were mentioned with regard to user interests:

- it is necessary to improve the sanitary status in the communities, i.e. collection and treatment of wastewater;
- the communities wish to be promoted as "green areas" in Poland, and in particular to jointly promote "agro-tourism";
- it is important to ensure a (continuously) good water supply.

### *Water Quality*

The following points were mentioned with regard to water quality:

- although the ground water resources were only succinctly assessed during Phase I, it appears that the most important ground water resources are free of pollution from waste water;
- the river Bystra and its tributaries are heavily polluted with regard to nutrients and organic matter, according to the Norwegian Water Quality Classification System they would all be in class V, "very bad"- although the local Polish Pollution Authorities expressed the view that the Norwegian criteria are too stringent for Polish conditions;

### *Pollution Sources*

With regard to pollution sources it was pointed out that:

- they were mapped to a satisfactory degree during the project;
- the relationship between municipal wastewater from households, institutions and small industrial plants, and pollution from agriculture had been assessed;
- surface run-off had been assessed only superficially.

### *Wastewater Treatment Plants*

With regard to wastewater treatment plants it was pointed out that:

- they had been mapped to a satisfactory degree;
- all the treatment plants had been visited;
- there is no data about the water quality in the inlets to the treatment plants.

## Environmental Information System

The importance of presenting the gathered environmental information in a systematic and integrated way was felt to be very important. It was explained that NIVA is currently developing a water quality information system (WaterQUIS). WaterQUIS is part of a modern Environmental Surveillance and Information System (ENSIS). NIVA co-operates with the two other companies in this project: The Norwegian Institute for Air Research (NILU) and NORGIT (a specialised company for information technology and geographical information systems).

ENSIS provides a system that is:

- A tool for resource and environmental planning and management
- A tool for environmental and natural resource specialists in their daily work and research.
- An information management system for environmental and natural resources issues.
- A tool for systematisation and integration of environmental data.

Furthermore, the benefits of ENSIS are to:

- Increase the quality and availability of information and thereby provide a support and a better basis for planning and decisions by environmental planners and politicians,
- Improve the information flow to environmental organisations and the general public, and thereby improve public awareness on environmental issues, involvement and participation in planning processes.

The Project group agreed that such a system could be of great interest in Poland and would like to be informed about the further development of ENSIS.

### **Follow-up of the Current Project**

The Project group was satisfied with the progress so far, and agreed that Phase-2 should be started as soon as the Norwegian grants are confirmed

An abatement strategy for the catchment will be presented at the planned seminar in July 1997. The seminar will be a 3-4 days seminar with about 100 participants. This shows that importance of the project for local and regional Polish authorities.

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