REPORT SNO 3926-98

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

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

Final report

Norwegian Institute for Water Research

REPORT

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Abstract

This report is the final report of the project: "Strategy for integrated Water Supply, Wastewater Treatment and Disposal System for Small Communes in Poland: *Case study - Master and Action Plans (MaAP) for the Bystra river catchment*". The 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 has been implemented by the Norwegian Institute for Water Research (NIVA) and has been funded by the Norwegian Pollution Control Authority (SFT). The Institute of Environmental Protection (IOS) in Poland has been responsible for the co-ordination in Poland, sponsored by the National Foundation for Environmental Protection and Water Management. The project provides an input to the process of wastewater master planning methodology in Poland, presented as a case study for the Bystra river catchment, and based on Norwegian procedures.

This report presents the main objectives, activities and conclusions of the project, as well as a short presentation of Norwegian experiences relevant to the project.
Five reports have been elaborated prior to this report, where the entire project development is described.

4 keywords, Norwegian	4 keywords, English
1. Hovedplan	1. Master and Action Plans
2. Forvaltning av vannressurser	2. Water Resources Management
3. Begrensning av vannforurensning	3. Water Pollution Abatement
4. Internasjonalt / bilateralt samarbeid	4. International / bilateral co-operation

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Strategy for Integrated Water Supply, Wastewater Treatment and Disposal Systems

for

Small Communes in Poland

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

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Preface

This project: "*Strategy for Integrated Water Supply, Wastewater Treatment and Disposal Systems for Small Communes in Poland; Case study – Master and Action Plan (MaAP) for the Bystra River Catchment*", 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. From the Norwegian side, the Norwegian Institute for Water Research (NIVA) has implemented the project, funded by the Norwegian Pollution Control Authority (SFT). The Institute of Environmental Protection (IOŜ), Warsaw, has been responsible for the co-ordination in Poland, sponsored by the Polish National Foundation for Environmental Protection and Water Management.

Six reports have been written during this project, namely:

- Programme of Sanitation and Water Protection in the Bystra River Catchment, Phase I (IOS, September 1996)
- Programme of Sanitation and Water Protection in the Bystra River Catchment, Phase II (IOS, December 1996)
- Strategy for Integrated Water Supply, Wastewater Treatment and Disposal Systems for Small Communes in Poland; Phase I, Data gathering (NIVA, April 1997)
- Programme of Sanitation and Water Protection in the Bystra River Catchment, Phase III (IOS, May 1997)
- Master and Action Plans (MaAP) Concept; Wastewater Management; Norwegian Methodology Illustrated with a Case Study for the Bystra River Catchment, Poland (NIVA, September 1998)
- Strategy for Integrated Water Supply, Wastewater Treatment and Disposal Systems for Small Communes in Poland: Final Report (NIVA, September 1998).

This report presents the principles of the Norwegian methodology for making master plans for wastewater management, based on SFT guidelines, and describes Norwegian experiences relevant to the project. The methodology is illustrated with a case study for the Bystra river catchment in Poland.

Key persons in the project have been:

- Prof. dr Barbara Osmulska-Mròz, Polish Project Manager (IOS, Poland)
- M.Sc. Grazyna Englund, Norwegian Project Manager (NIVA)
- Ass. prof. Krzysztof Wierzbicki, Chairman of the Steering Committee (IBMER: Institute for Building, Mechanisation and Electrification of Agriculture, Poland)
- M.Sc. Gunnar Fr. Aasgaard, Norwegian member of the Steering Committee (ANØ; Romerike Environmental Competence Centre, Norway)
- M.Sc. Stig A. Borgvang, Project co-worker (NIVA).

Oslo, 28 September 1998

Grazyna Englund
Project manager

Contents

Summary

Background
The starting point for the project was 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”. The four main communes in the catchment area have established “the Association of the Bystra Valley”, whereby these communes agree to implement common activities for the purpose of environmental protection, development of tourism, fishing, and recreation in the catchment area of the Bystra river.

Catchment
The Bystra river catchment is 295,7 km^2 and is located geographically on the Naleczów Plateau. The Bystra river is 34 km long; about 70 km when all tributaries are included.
The Bystra valley is the ecological regional corridor connecting the protected area system of the Lubelski Highland rivers to Bystrzyca and Wieprz. Protected areas cover the larger part of the catchment, namely:

- Kazimierzowski Landscape Park (27 % of the total catchment area) and its buffer zone 73 % of the total catchment area)
- Sanatorium area in Nałęczów.

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

Objectives/Methodology
The goal of the project was divided into four categories viz. technology transfer, development of professional competence and network, educational input and follow-up work.

The presentation of the Norwegian methodology for elaboration of Master Plans represents the main Norwegian contribution to the project. In addition, short presentation of Norwegian experiences relevant to the project have been given (Regional co-operation for water supply, wastewater and waste management; Rural area management; Classification of Environmental Quality in Freshwater in Norway and *En*vironmental *S*urveillance and *I*nformation *S*ystem (ENSIS)).

Water supply and sewerage
Current situation
Water supply
The waterworks infrastructure is well developed in Nałęczów and Wąwolnica, where more than 80 % of the households are supplied by a water distribution net. The water systems serve about 54 % of the households in Kazimierz Dolny, but only 0,6 % in Wojciechów. The other inhabitants have individual, uncontrolled water supply from private wells.
Wastewater
The sewerage and wastewater treatment infrastructure is very poor in the Bystra river catchment. Biological treatment plants exist only in the two towns; Naleczów and Kazimierz Dolny. These systems do not serve the total urban area and need modernisation and development.

Pollution sources
The main pollution sources of the water resources in the catchment area are; Point sources: households, industry and institutions, and diffuse sources: surface run-off (mainly from agriculture) and some background pollution.

Abatement strategy
The structure of the report on Master and Action Plans is based on the current Norwegian Master Plan guidelines for wastewater management (SFT, 1994). Elements from the Norwegian guidelines on setting environmental objectives for water resources (SFT, 1997) is also included in the report.

The main purposes of the Master Plan report are:
1. To provide politicians and other decision - makers of communes, local authorities, and Regional Boards of Water Management connected with the Bystra river catchment with brief and concise information as regards the sanitation in the area, based on which they can decide on measures to improve the sanitation situation.
2. To provide parties without technical background with information connected to development of a Master Plan for wastewater management.
3. To contribute in the further development of Polish Master Plan methodology, using the Bystra river catchment as a demonstration case for a conceptual presentation of Norwegian methodology.

The purpose of the Master Plan is to describe in a succinct way the tools necessary to establish the infrastructure required and to improve the environmental conditions. Local and regional authorities should use the plan when deciding on the strategy to be adopted in order to reach the goals set.

The four municipalities in the Bystra River Catchment; Nałęczów, Kazimierz Dolny, Wąwolnica and Wojciechów, have set the main objectives, based on their common vision for the region:
- Firstly:
  1. To improve the sanitation living conditions by establishing satisfactory treatment solutions for all inhabitants in the area concerned (extension of water supply facilities (1 a), sewerage systems, wastewater (1b) and waste management)
- Secondly:
  2. To reduce erosion/sedimentation in the region
  3. To establish three retention "basins" in the river Bystra and its tributaries
  4. To prevent a further lowering of the ground water level in the river Bystra's catchment area
  5. To develop satisfactory waste management facilities
  6. To reinforce the «green area image» of the catchment by means of the above-mentioned and the promotion of ecological education.

Gaps between status and objectives :

Objectives		Status[1)]					Gap				
Objective	Oper. goal[2)]	Wo	Na	Wą	KD	B	Wo	Na	Wą	KD	B
1a	100 %	1	86	83	54	-	99	14	17	46	-
1b	100 %	2	19	7	~ 50[3)]	-	98	81	93	~ 50	-
2a-b	«PHARE» [4)]	-	-	-	-	-	-	-	-	-	-
3[5)];	3 new basins	0	2	0	0[5)]	-	1	0	1	1	-
- BOD5	< 8 mg/l	-	-	-	-	4,7	-	-	-	-	OK
- Tot N	< 10 mg/l	-	-	-	-	4,9	-	-	-	-	OK
- Tot P	< 0,25 mg/l	-	-	-	-	0,29	-	-	-	-	0,04
- Bacteria	< 0,1 (index)	-	-	-	-	0,4	-	-	-	-	0,3
4[6)]	GWL>1998	-	-	-	-	-	-	-	-	-	-
5	In operation	No	No	No	Yes	-	Missing in 3 com.			OK	-
6	90 % score[7)]	-	-	-	-	-	-	-	-	-	-

The focus of the Master Plan is to identify measures to meet the objective of establishing satisfactory sanitation conditions, with regards to *sewerage systems and treatment solutions.* In the *prioritisation* of the measures, the influence on the other above listed objectives is also evaluated.

The Polish Institute of Environmental Protection (IOŜ) has launched and evaluated three different approaches to wastewater management in the Bystra catchment (for totally 32,078 number of population), representing different combinations of the three categories of wastewater treatment, viz.:

- Alternative I; 8 central and 7 local treatment plants, 17 sites with individual solutions
- Alternative II; 6 central and 6 local plants, 57 sites with individual solutions
- Alternative III; 9 central and 4 local plants, 38 sites with individual solutions.

These three alternativeshave been described and a cost-effective analysis (CEA) has been carried out, taking into account the user interests in the area. In the Bystra catchment, the CEA approach has been applied to select measures based on the ratio between the costs and the benefit from the measure. Ideally, the benefit parameters should be the same as the parameters having the largest «gap» between the current situation and the defined objectives, see NIVA-II, table 4 in section 3.6.1, which are:

- Number of persons without satisfactory sanitation conditions;
- Phosphorus concentration in the Bystra river; and
- The bacteria concentration in the Bystra river.

In order to improve the gap between the present situation and the defined objectives, some recommendations have been suggested, based on nine **strategic** elements:

a) *Continued monitoring and documentation of the environmental situation, to improve the basis for decision on measures*
b) Evaluation of centralised or decentralised solutions
c) Importance of phosphorus removal
d) Sludge treatment and disposal
e) Wastewater management; run by the municipality itself, through regional co-operation or by a private wastewater company
f) Surveillance programme to evaluate effects of measures
g) Information policy
h) Financial strategy for cost recovery (capital and operational costs), and
i) Strategy regarding industry and agriculture.

Recommended measures

Based on the cost-effective analysis (NIVA-II, Section 3.6.2), alternative II was chosen as the best group of measures for the Bystra catchment. It is, however, underlined that only capital costs were taken into account in the CEA. No data of operational/maintenance costs were available in the project documents. This alternative includes these measures:

- 6 central wastewater treatment plants
- 6 local wastewater treatment plants
- 57 individual solutions.

Costs and financial options

Other than in exceptional circumstances, the full cost of providing a wastewater service, including charges for loans and depreciation, should be charged the users of the service.

Although charging according to use or benefits derived seems simple, there are a number of complex issues involved. The development of user charges may be divided into three phases:

- Phase I : Identify the total costs to be recovered from the customers
- Phase II : Allocate these costs to different customer classes
- Phase III : Design a tariff structure to recover the costs from each customer class.

1. Master and Action Plans for the Bystra River Catchment

1.1 Methodology

The presentation of the Norwegian methodology for elaboration of the Master Plan represents the main Norwegian contribution to the project.

The structure of the report on Master and Action Plans is based on the current Norwegian Master Plan guidelines for wastewater management (SFT, 1994). Elements from the Norwegian guidelines on setting environmental objectives for water resources (SFT, 1997) is also included in the report.

The main purposes of the Master Plan report are:

1. To provide politicians and other decision - makers of communes, local authorities, and Regional Boards of Water Management connected with the Bystra river catchment with brief and concise information as regards the sanitation in the area, based on which they can decide on measures to improve the sanitation situation.
2. To provide parties without technical background with information connected to development of Master Plan for wastewater management.
3. To contribute in the further development of Polish Master Plan methodology, using the Bystra river catchment as a demonstration case for a conceptual presentation of Norwegian methodology.

The emphasise on objectives, measures and costs is common for all Master plans. The concept is shown in Figure 1.

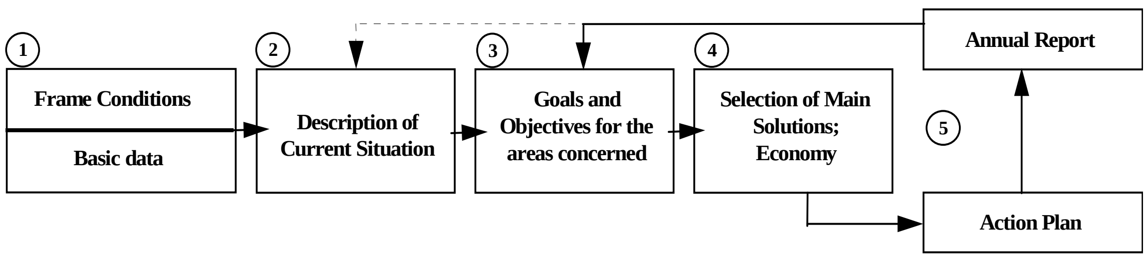


Figure 1. The concept of a Master Plan

The Master Plan should be «user friendly», both for politicians and administrators. Two versions of the plan are recommended, namely:

- Plan - version 1: One *summary report* addressing the politicians and decision-makers. Conclusions, main assumptions and evaluations should be emphasised.

Plan- version 2: One detailed, *technical oriented plan* meant for the technical administration in the municipality. This main report should present, in detail, facts, assumptions, evaluations and measures. Procedures for future control and documentation of achieved results should also be presented in this version.

The Norwegian Pollution Control Authority (SFT) recommends that the political part of a Master Plan (plan - version 1) should have the following content:

PREFACE
SUMMARY
1. FRAME CONDITIONS
2. DESCRIPTION OF CURRENT SITUATION
   2.1 The water resources related to user interests in the area
   2.2 Pollution sources
   2.3 Infrastructure; location and technical condition
   2.4 Management and institutional options
   2.5 Economy
3. GOALS AND OBJECTIVES
4. ABATEMENT STRATEGY AND MEASURES
   4.1 The gap between status and objectives
   4.2 Identification of potential measures and their cost-effectiveness
   4.3 Strategy to meet the objectives
   4.4 Selection of measures for the planning period
   4.5 Costs and financial options
5. ACTION PLAN
6. ANNUAL REPORT

The Polish partner in this bilateral project, the Institute of Environmental Protection (IOS), Warsaw, has prepared the plan - version 2 documents, and presented in these three volumes (IOS-I, 1996; IOS-II, 1996 and IOS-III, 1997). Most information about the Bystra river catchment in the plan/version 2 document (NIVA-II, MaAP, 1998) is based on these three IOS reports. The direct contacts between NIVA and the Polish partners during visits of the catchment represent an additional indispensable source of information.

1.2 Objectives for the Communes in the Bystra River Catchment

The municipalities in the Bystra river catchment are facing large environmental challenges, both of regional and local character. To attain the agreed environmental objectives, without being a threat to other important public goals, the politicians demand a cost-effective strategy.

In Norway, it is recommended that each municipality develops a Master Plan in order to develop an integrated approach to the wastewater sector, and to balance different elements influencing the water quality. For the environmental authorities, the plan is a contribution to the municipalities when setting environmental goals for the water resources. This reflects the Norwegian policy, with more frequent use of *environmental* standards than detailed *technical* standards. «Management by setting objectives» will then be the local approach for wastewater management, and achieved results will be reported to the authorities.

The four municipalities in the Bystra River Catchment; Nałęczów, Kazimierz Dolny, Wąwolnica and Wojciechów, have established a co-operation (Association for the Bystra Valley), based on their common vision for the region:

- Firstly:
  - To improve the sanitation living conditions by establishing satisfactory treatment solutions for all inhabitants in the area concerned (extension of water supply facilities, sewerage systems, wastewater and waste management)

- Secondly:
  - To reduce erosion/sedimentation in the region
  - To establish three retention "basins" in the river Bystra and its tributaries
  - To prevent a further lowering of the ground water level in the river Bystra's catchment area
  - To develop satisfactory waste management facilities
  - To reinforce the «green area image» of the catchment by means of the above-mentioned and the promotion of ecological education.

The focus for the Master Plan is to identify measures to meet the objective of establishing satisfactory sanitation conditions, with regards to *sewerage systems and treatment solutions.* In the *prioritisation* of the measures, the influence on the other above listed objectives is also evaluated.

The purpose of the Master Plan is to describe in a succinct way the tools necessary to establish the infrastructure required and to improve the environmental conditions. Local and regional authorities should use the plan when deciding on the strategy to be adopted in order to reach the goals set.

1.3 Current Situation

The current sanitation situation: regarding water supply from the municipal waterworks and connection to municipal wastewater treatment plants is shown in figure 2.

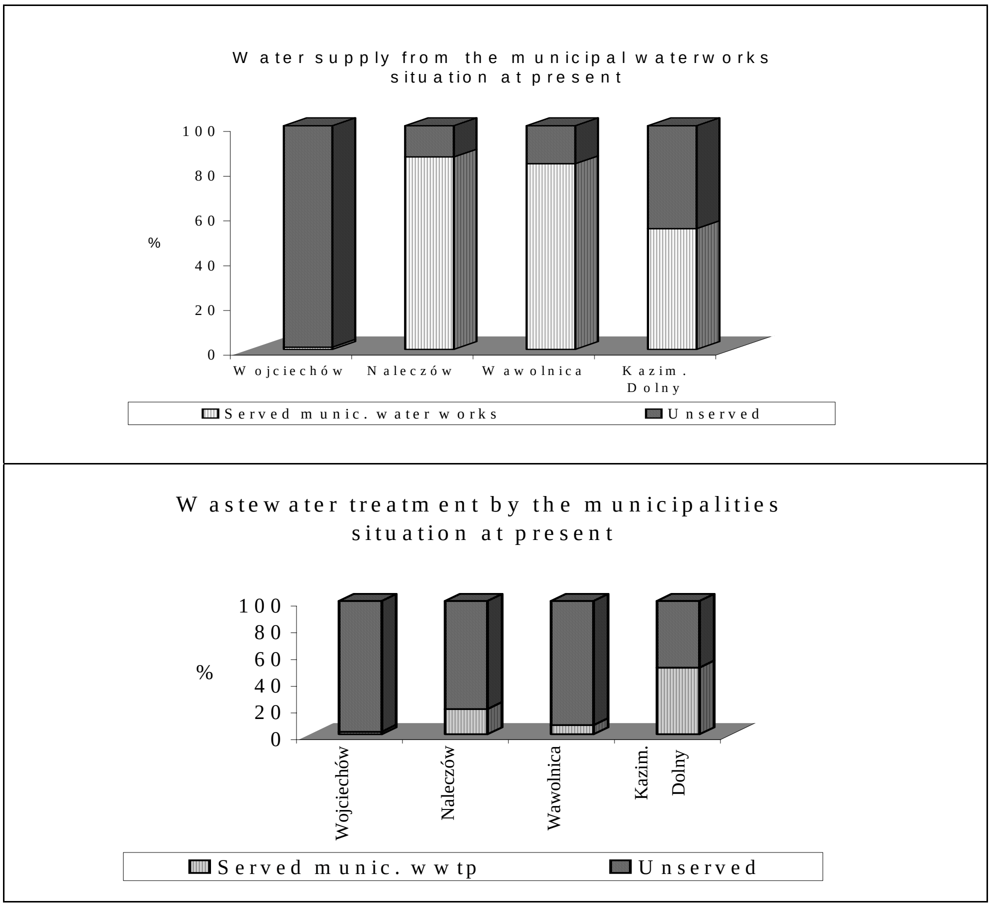


Figure 2. Current sanitation situation

The Polish Institute of Environmental Protection (IOŜ) has launched and evaluated three different approaches to wastewater management in the Bystra catchment, representing different combinations of the three categories of wastewater treatment, viz.:

- Alternative I; 8 central and 7 local treatment plants, 17 sites with individual solutions
- Alternative II; 6 central and 6 local plants, 57 sites with individual solutions
- Alternative III; 9 central and 4 local plants, 38 sites with individual solutions.

These three alternatives were described and a cost-effective analysis (CEA) was carried out, taking into account the user interests in the area. In the Bystra catchment the CEA approach has been applied to select measures based on the ratio between the costs and the benefit from the measure. Ideally, the benefit parameters should be the same as the parameters having the largest «gap» between the current situation and the defined objectives, see NIVA-II, table 4 in section 3.6.1, which are:

- Number of persons without satisfactory sanitation conditions
- Phosphorus concentration in the Bystra river, and
- The bacteria concentration in the Bystra river.

In order to improve the gap between the present situation and the defined objectives, some recommendations have been suggested, based on nine **strategic** elements:

a) *Continued monitoring and documentation of the environmental situation, to improve the basis for decision on measures*
b) Evaluation of centralised or decentralised solutions
c) Importance of phosphorus removal
d) Sludge treatment and disposal
e) Wastewater management; run by the municipality itself, through regional co-operation or by a private wastewater company
f) Surveillance programme to evaluate effects of measures
g) Information policy
h) Financial strategy for cost recovery (capital and operational costs), and
i) Strategy regarding industry and agriculture.

Element a; Continued surveillance and documentation

The overall goal in the Bystra catchment is currently to improve the sanitation situation for the inhabitants. Measures are identified to improve this situation. In the «next generation» of measures, however, the benefits will be more marginal. Trustworthy information about water quality, infrastructure and other topics will then be even more important than today, when the most cost effective solutions will be selected.

- *It is therefore recommended to continue the monitoring of the water quality in the Bystra river, but the surveillance programme should also include some flow proportional samples. This will make it easier to develop a mass balance budget in the catchment for phosphorus, organic matter and other relevant parameters. Such a mass balance is necessary in order to estimate the benefits of future measures.*

Element b; Centralised or decentralised solutions

There are many good wastewater treatment systems available in the market, also for small wastewater treatment plants. The conventional sewerage systems, connecting large areas to one central wastewater treatment plant are therefore seldom the most cost-effective approach to wastewater management. Decentralised solutions, combined with remote control run by a central operational unit, would more often be the best concept.

- *In each case a cost-effective analysis should be performed.*

Element c; Importance of Phosphorus removal
Phosphorus and phosphorus concentrations represent the largest gap between the current situation and the objectives, regarding the water quality in Bystra river. This indicates increased eutrophication, which does not necessarily represent a major problem in the *river*. In the planned *retention basins*, however, eutrophication represents an important problem, with algal blooms as a potential effect.

- *It is therefore recommended that the central and local wastewater treatment plants be prepared for chemical precipitation, to be implemented at a later stage.*

Element d; Sludge treatment and disposal

Nałęczów wastewater treatment plant has well functioning facilities for sludge treatment; dewatering (Bellmer press) and drying beds. The capacity allows to some extent treatment of sludge also from other wastewater treatment plants in the area.

- *It is therefore recommended to evaluate if the sludge from the whole catchment could be transported to Nalêczów wastewater treatment plant, using a filter press for dewatering and lime stabilisation.*

Element e; Wastewater management
A wastewater treatment plant represents complex mechanical, biological and chemical processes. Skilled personal is required to run such plants. The larger the plant, the higher is the need for competence and capacity. In the Bystra catchment, the construction of several treatment plants is planned, which will be operating in the near future.

- *It is recommended to establish one central operational unit to run these plants, including the sewerage systems, for all the communes involved.*

A central operational unit will be able to recruit and educate staffs, which could run and maintain effectively the central and local wastewater treatment plants and sewerage systems, based on proper control systems for alarms and process control. This unit could also supervise the individual treatment solutions, both for technical control and to ensure that the septic tanks are emptied according to agreed frequency.
A central operational unit could be administrated from the four communes involved, as an external technical department or a company. Such a department (company) could also be responsible for the whole wastewater management in the catchment, including the financial arrangements. If a company is established, it could be 100 % owned by the four Bystra communes.

- *It is strongly recommended that such collaboration between the four Bystra communes will be elaborated.*

Element f; Surveillance programme to evaluate effects of measures
There are plans for implementing many pollution abatement measures in the Bystra catchment the forthcoming years. These measures are expected to have well defined effects, both for the inhabitants directly and for the environment. Documentation should be made on these effects, in order:

1. To motivate the inhabitants and the politicians to fulfil the actions proposed in the Master Plan for Wastewater Management
2. To adjust or alter the measures based on the experienced effects.

- *It is recommended that such a surveillance programme is designed and implemented, and that the results are reported yearly in the Annual Report, ref. Section 3.8.*

Element g; Information policy
It will be costly to upgrade the infrastructure in the four Bystra communes. Most of the costs will probably have to be paid by the inhabitants, directly through fees for water and wastewater and indirectly through local taxes. The inhabitants should be informed about the need for these infrastructure investments, operational and maintenance costs, as a motivation for their payment.

Regularly, external information about the environmental situation in Bistro catchment could also be an effective element in marketing the catchment as a «green area», supporting the tourism in the four communes. An Internet based environmental information system might be a proper tool for such information.

Element h; Financial strategy for cost recovery
The «customers»; inhabitants, institutions and business activities should finance the costs for water supply, wastewater treatment and waste management. This is a major principle in Norway, where the municipalities are expected to charge the users 100 % of the running costs (capital costs, operational and maintenance costs) for these services.

A full cost recovery policy may be easier to implement if the wastewater management is completely delegated to an external company, as mentioned above.

Element i; Strategy regarding industry and agriculture
There is very little industrial activity in the Bystra catchment, a situation that is not expected to change in the future.

- *When planning the new central and local wastewater treatment plants, combined treatment with the industrial wastewater should, however, be evaluated.*

The agricultural activity in the Bystra catchment, however, is of great importance for the water quality in the Bystra river and it's tributaries, as well as for the Bystra communes in general.

Several measures should be implemented to reduce the environmental impact of agricultural activity. This is, however, not included in the Master Plan for Wastewater Management. Wawolnica commune has an interesting approach to the problem, trying to motivate the farmers to aggregate their farms into larger units. Larger farms will more efficiently enable the change of land use and improve operational procedures, all leading to reduced discharges of nutrients and pesticides into the water resources.

- *It is strongly recommended that this process in Wąwolnica is continued, and that the other three communes also define a strategy to reduce the pollution from agriculture.*

1.4 Selection of measures for the planning period

Based on the cost-effective analysis (NIVA-II, Section 3.6.2) alternative II was chosen as the best group of measures for the Bystra catchment. We will, however, underline that only capital costs were taken into account in the CEA. No data of operational/maintenance costs were available in the project documents. This alternative includes these measures:

- 6 central wastewater treatment plants;

Mechanical-biological treatment (activated sludge or biological filters), prepared for desinfection of the effluent and with an option of adding chemical precipitation. Container-plants are preferred when capacity doesn't exceed 200 m^3/d:

- Palikije (204 m^3/d)
- Nałęczów (3320 m^3/d)
- Drzewce (180 m^3/d)
- Wąwolnica-Mareczki (410 m^3/d)
- Celejów (230 m^3/d)
- Bochotnica-Kazimierz Dolny (expansion of the existing wastewater treatment plant)

• 6 local wastewater treatment plants (same configuration as mentioned above):

- Łubki (50 m^3/d)
- Czesławice (23 m^3/d)
- Łopatki (85 m^3/d)
- Witoszyn (36 m^3/d)
- Wierzchoniów (43 m^3/d)
- Stok (32 m^3/d)

• 57 individual solutions (13 331 PE; 2000 m^3/d); Septic tanks with or without infiltration to the ground, dependent on local conditions (permeability, contamination of private wells).

Sludge treatment; Central sludge treatment at Naleczów wastewater treatment plant, using a filter press for dewatering and lime stabilisation, for further use as granulated fertiliser.

1.5 Costs and financial options

Other than in exceptional circumstances, the full cost of providing a wastewater service, including charges for loans and depreciation, should be charged back to the users of the service.

Although charging according to use or benefit derived seems simple; there are a number of complex issues involved. There might be three phases in developing user charges:

- Phase I : Identify the net costs to be recovered from customers
- Phase II : Allocate these costs to different customer classes
- Phase III : Design a tariff structure to recover the costs from each customer class.

2. Special Topics from Norwegian Practice

2.1 Regional Co-operation

To obtain cost-effective solutions, the municipalities are encouraged to co-operate in setting water quality objectives for the regional water resources, and in planning/implementing measures to reach these objectives.

Several municipalities in Norway have established co-operation within water supply, wastewater and waste management. The benefits from such co-operation is expected to increase as the tasks get more complicated and more resource demanding. We will in this Section present some examples from the Romerike region, just East of Oslo, Norway.

2.1.1 Water Supply

In 1992, the Norwegian Parliament decided to establish a new Oslo Airport at Gardermoen, 60 km North/East of Oslo. The site was just on the boarder of two small/medium sized municipalities, Nannestad (8 000 inhabitants) and Ullensaker (19 000 inhabitants). A new Oslo airport in these two small municipalities represented a big challenge for the infrastructure in Nannestad and Ullensaker.

The situation in 1992 with regard to water supply was:

- Nannestad:
  - 9 private waterworks
  - Only one of the waterworks had passed the national acceptance test
  - The distribution net was organized as a public owned company (NAVAS)
  - Not satisfactory hygienic water quality
  - Not satisfactory raw water sources
  - The water intakes were in bad conditions
  - The municipal Master Plan for water supply was not integrated in the plans for the private waterworks

- Ullensaker:
  - One municipal waterworks (accepted)
  - The distribution net was operated by the municipality
  - Limited capacity; not enough for the new airport
  - Periodically high concentrations of humic substances
  - Unstable conditions in the distribution net
  - A lot of complaints from the users

Objective and strategy

When the decision was made for the new Oslo Airport, the two municipalities agreed on co-operating on improvement of the local infrastructure. The objective was to adapt the water supply, wastewater and waste management at the airport to the infrastructure for the inhabitants in Nannestad and Ullensaker. The information of the current situation (1992) was evaluated as basis for the elaborated solutions.

A project group was established, with representatives from the future airport administration, the two municipalities and the regional authority (county). Main strategic evaluations and conclusions:

- Four raw water sources were evaluated, both surface water and ground water
- Raw water sources were decided to be the watershed *Rotu* for phase 1 (20 years) and then the lake *Hurdalsjøen*
- Establishing of an Inter-municipal waterworks for Nannestad and Ullensaker was recommended.

Company profile

The inter-municipal waterworks, *Univann AS*, was established 30. June 1994. The company profile can briefly be described with these key points:

- Inter-municipal, wholesale business
- Two customers; the municipalities Nannestad and Ullensaker
- The inhabitants, the industry and the institutions are subscribers of the two municipalities
- The ownership is split in 20 % (Nannestad) and 80 % (Ullensaker)
- Full cost recovery, but no profit
- No staffs in the company; Personnel are engaged from the technical staffs in Nannestad and Ullensaker
- The managing board has 7 members (Nannestad 3 and Ullensaker 4)
- An operational board has 5 members (Nannestad 2 and Ullensaker 3)

2.1.2 Wastewater Management

Thirteen municipalities in the Romerike region have several small and medium sized wastewater treatment plants (WWTP). They all have their own staff, but the municipalities have engaged a company (ANØ), owned by the municipalities, to assist in running the plants.

With a few exceptions, the first generation of WWTPs in Norway started as late as during the 1970’s. Due to heavy algae growth in the lakes, especially Mjøsa, the main emphasize was to remove phosphorus. This is the scientific basis why a vast number of Norwegian WWTPs are built as chemical treatment plants. This in contrary to most countries, that have biological treatment as their priority number one. The total treatment capacity in 1993 for WWTPs in Norway was 4,8 million PE and the distribution of treatment concepts is given in Figure 3 (Source: Norwegian Bureau of Statistics).

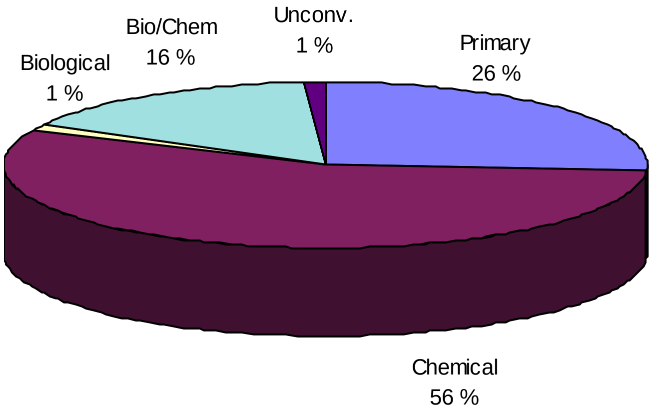


Figure 3. The distribution of treatment concepts in Norwegian wastewater treatment plants

Today's WWTPs consist of three main categories:

- Biological/chemical treatment included nitrogen removal (plants > 30 000 PE)
- Chemical precipitation (to lakes and fjords)
- Mechanical treatment (primary/screen before discharging to the sea)

Operation of WWTPs require skilled staffs

After the first phase of building treatment plants the need for skilled personnel was enormous. There were no special training within the area of operating treatment plants, and there were no managing engineer or operators available. It was common to recruit staffs with a profession as an electrician or a plumber. It was quite uncommon to hire personnel with a biological or chemical education.

If the vast investment should give pay-back to the environment, most people realize that the level of know-how had to be considerably increased. This challenge was much easier to meet for the larger treatment plants, > 30.000 PE. These treatment plants had a mixture of engineers and operators, and their only task were to run the plant. It was fare worse, for the operators of smaller treatment plants, to realize the importance of planned maintenance and chemical reactions. All maintenance was more or less fulfilled as «fire-fighting». And as a consequence of this, the performance of the large plants were fare better than of the smaller ones.

Inter-municipal companies

A large number of treatment plants are organized as Inter-municipal companies. For municipalities with common recipient, this is a logical way of organizing the wastewater management. The Inter-municipal companies are either responsible for the:

- entire wastewater treatment, including the total sewerage systems,
- the wastewater treatment, main sewers and main pumping stations, or
- limited to wastewater treatment

Operational assistance services («Circuit Riders»)

The first Circuit Rider programme was introduced in the late 1970’s and it became a national programme during the 1980’s. Even if the Circuit Riders more or less did the same kind of work, their background were quite different:

- Inter-municipal companies
- Private consulting companies
- Counties

Circuit Riders have the following tasks:

- Frequent on-site visits to identify potential improvements in the routines and the operational procedures
- Technical assistance from highly qualified persons with experience from wastewater design and operation
- Monitoring and evaluation of the performance (treatment efficiency)
- Record keeping and reporting to the environmental authorities
- Theme meetings, study tours; in order to develop a positive working environment for the operators.

Centralized management of several WWTPs

During the autumn 1998, six municipalities in the Romerike region are elaborating a concept for centralized management of their small and medium sized WWTPs. Organizing all the staffs in one operational unit is expected to have many advantages, such as:

- Increased capacity in week-ends, holidays, vacancies, alarm situations etc.
- Regional utilization of local expertise
- Better understanding of and possibilities for implementing advanced equipment for process control
- Central treatment and disposal/marketing of sludge

Conclusions from the evaluation will be drawn in December 1998. If this turn out to be positive, the concept might be tested in 1999.

2.1.3 Waste Management

The four municipalities Eidsvoll, Ullensaker, Nannestad and Hurdal established the waste management company ØRAS in 1981, serving 47 000 inhabitants in the region. The approach for the municipalities was to prepare and operate one common waste deposit, with all the needed facilities according to the environmental standards.

During the last 17 years, the waste deposit has developed to be a modern plant for waste separation and treatment, represented with these process units:

- Reception of domestic solid waste for recycling
- Area for treatment of polluted soil
- Separation of municipal waste («OptiBag»)
- Composting
- Gas utilization (green house)
- Treatment of leachate water

Organisation and management

ØRAS is a public owned company, where the four municipalities equally are responsible for the financial situation in the company. ØRAS has a staff of 10 persons and a revenue of about 14 million NOK (1998).

The managing board has 4 members; one from each of the municipalities. The general assembly has 14 members, where the representation from the municipalities is proportional with the number of inhabitants.

2.2 Rural Area Management

2.2.1 Introduction

Onsite wastewater treatment treats about 25% of all domestic sewage in Norway. A major part of these onsite solutions are old and in a strong need for upgrading. The distribution of onsite solutions in Norway is given in figure 4 (Source: Norwegian Bureau for Statistics)

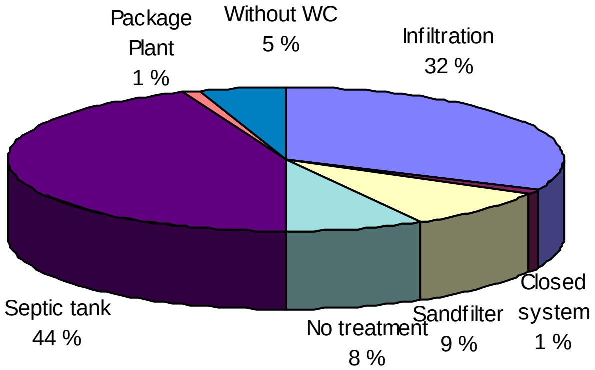


Figure 4. Distribution of onsite (individual) solutions

Today's solution for onsite wastewater treatment consists of three main groups:

- Natural systems (mostly infiltration systems)
- Package Plants (conventional treatment systems)
- Septic tanks (septic tanks as the only treatment before discharge into the recipient)

2.2.2 Onsite Wastewater Regulations

Effluent permits for single houses or group of houses, i.e. less than seven houses, are always given as temporary permits. The regulatory authorities consider it important that decentralised solutions are connected to a centralised system at a later stage for two reasons:

- When a new centralised system is established, connection fees from new and old houses will be a part of the financing
- It secures that separate solutions are removed.

Effluents from decentralised solutions are strongly regulated in Norway. On the basis of The Environmental Protection Act, all areas within decentralised solutions are regulated by sub-standards of this Act. However, most other countries regulate decentralised solutions by Guidelines, Standards or Codes of Practices.

New permits

Each municipality has the authority to grant effluent permits in rural areas, but in an urban area they can only grant permits to dwellings for specific reasons. Such reasons may be, *inter alia*, farmers (next generation), re-construction after fire and upgrading existing onsite treatment.

In an urban area, the municipality can grant single effluent permits on the basis of an approved plan for the area. This plan is called a "Framework Agreement", based on a Master Plan for the area. For a specific area, the municipality develops a Master Plan that may consist of a wastewater treatment plant for the most densely populated area, and a Framework Agreement for area(s) that either are urban or rural. A Framework Agreement normally gives the municipality authority to grant a specific number of effluent permits per year for a given time period (i.e. 5 years).

Procedure for applying for and handling of an effluent permit

1. The Applicant has a meeting with the municipality. He receives a map of the area. It is checked whether the area is designed for decentralised solutions, according to the Master Plan.
2. An expert will perform a soil test (infiltration test), which is the design basis for an infiltration system. This is based upon the policy that an infiltration system should always be the first (default) choice, whenever possible. A soil test consists of soil samples for grain size distribution and a percolation test. If the expert concludes that this area does not fulfil the criteria for infiltration systems; the second choice will be package plants (factory-built treatment plants).
3. The effluent treatment system is considered as part of the public health approach. Among these considerations are local sources for drinking water, feeding possibilities for animals, recreational areas etc.
4. The municipality will, for each permit, require that a named person, not a company, is responsible for the treatment system. This person must be pre-qualified for this type of work.

Besides an effluent permit, the Applicant will need a permit from the local road authority, to connect the private road to the public road, and the health authority must accept the specific source for drinking water purposes.

A representative from the municipality will normally inspect the treatment system during construction, but there is no follow-up system during the operational phase. An infiltration system will normally be included in the municipality's mandatory system for emptying the septic tank every second year. The package plant will be included in the producer’s systems for maintenance (normally three times per year).

Existing individual treatment systems

As a local environmental authority, the municipality is responsible for both new and old treatment systems. According to the legislation for the rural area, the municipality can require that the house owners with old discharge permits should apply for a new permit, within a given time limit, even if the discharge permit was granted before the current legislation was set in operation. If the house owner does not apply within the defined time limit, the municipality can require, according to The Environmental Protection Act, that the treatment system must be upgraded. If the municipality will enforce this part of the Environmental Protection Act, i.e. require rehabilitation of an old treatment system, this must be as a part of a plan to improve the environmental conditions for a larger area or watershed.

2.2.3 Experiences

Criteria for effluent permits in rural areas are well defined in Norway, based on established environmental laws. The current system has obviously weak points, such as:

- **The procedure requires a considerable number of man hours**

Each application is considered firstly within the municipality. Past experiences are neglected and there are no performance-based records from similar type of treatment within the same area.

Even if the municipalities have the necessary authority to handle decentralised effluent permits, the regulations set by the state and the counties are so limited that the municipalities, in most cases, have to refuse. As a consequence, a vast number of applications must be handled as complaints by the counties. The Department of Environment can thereafter handle a refusal from the counties. This requires fare more resources than 'the amount of pollution' decentralised solution represents.

- **Performance Based Regulation**

In Norway, as in most countries, there is no Performance Based Regulation. In accordance with the «Sub-law regulating effluent from decentralised treatment», the municipality is responsible for the control of the treatment system during construction and operation. However, the municipalities devote all their resources to the application and construction elements and nothing to the operational element. This is also a consequence of how the municipalities traditionally operate within other areas.

- **Framework Agreement**

Framework Agreements were introduced during the last revision of the «Sub-law regulating effluent from decentralised treatment», in 1992. As a consequence, the experiences are very limited, but this is a system with good prospects.

In the process of a Framework Agreement, the consequences of each single effluent are not considered. The geographical area is the whole area. The total contribution from all decentralised solutions, both existing and new, can be considered on the basis of soil tests, water analysis etc. Based upon this information, the total number of single effluent permits and the type of treatment can be decided.

The future system of a Framework agreement should incorporate an element of Performance Based Regulation. A few central points within the area of Framework agreements could be established and be monitored on a regularly basis. These points should be a part of the effluent permits and be treated as an effluent from an ordinary Public Owned Wastewater Treatment Plant, i.e. making use of process control, which is available in most markets.

2.2.4 Laws and Regulations

- **The Environmental Protection Act**
  All Regulations within the area of Environment have the authorisation from this Act.

- **Regulation of effluent from decentralised wastewater treatment plants**
  Covers all solutions used in rural areas. The Regulation also clearly defines where to use decentralised solutions. In principal, decentralised solutions can only be used within an area of less than seven houses or cabins, or an establishment corresponding to less than 35 PE (i.e. café,

school etc.). A group of houses is by definition houses within a distance of 100 meters of each other

- **Technical Regulations;**
  A part of "Regulation of effluent from decentralised wastewater treatment plants.
  Technical Regulations are a major part of the Regulation of effluent from decentralised wastewater treatment plants. The Technical Regulations specify the design in detail for Natural Treatment Systems.

- **«Type Approval» of Package Plants**
  According to Technical Regulations all package plants must be «Type Approved» by The Norwegian Pollution Control Authority. Requirements for «Type Approval»:

- Structural
- Durability
- Field testing
- Installation instruction
- Maintenance Contract with a competent Maintenance Contractor

The Maintenance Contract is a part of the effluent permit. In a case of a non-fulfilment of the Maintenance Contract, either by the owner or by the Contractor, it will also be a non-fulfilment of the effluent permit.

2.3 Classification of Environmental Quality in Freshwater in Norway

This document is based on SFT-guideline 97:04, ISBN 82-7655-368-0 and documents drafted by Mr Jon-Lasse Bratli (NIVA).

The main purpose of the Norwegian water quality classification system is to give different people in the central, regional and local administrations, consulting engineers and scientific researchers a uniform and objective tool for evaluation of environmental quality status and trends in Norwegian watercourses.

The system should assist in the development of goals for environmental quality, and "translates" environmental observations from biological and chemical parameters, and concentrations to concepts that are useful for decision-makers and of interest for the public.

Earlier issues of the classification system were published in 1989 and in 1992. The aim of this document is to present a short version of the revised guideline published by the SFT in 1997. The revised edition includes some adjustments of practical and technical character, due to earlier misunderstandings and more recent data. New national regulations and the inclusion of relevant elements from EU-directives have made a revision necessary.

2.3.1System structure and limitations

Table 2.3.1 shows the classification of environmental *quality status* and *suitability* related to adequate usage of the watercourse.

Table 2.3.1. Concepts used in the classification system

	Quality status		**Suitability**
Basis:	Based on measured concentrations		Adequate usage associated with a given water quality
Classes:	**Nutrients, org. matter etc.:** I = Very good II = Good III = Fair IV = Bad V = Very bad	**Micro pollutants:** I = Slightly polluted II = Moderately polluted III = Markedly polluted IV = Severely polluted V = Extremely polluted	**Four classes:** 1= Highly suitable 2= Suitable 3= Less suitable 4= Unsuitable

Classification of quality status is based on measured concentrations which have two components; a natural component which stems from natural processes in the catchment area, and a component which stems from human influence, i.a. acid rain, effluents from industry and sewage, and agricultural runoff. The latter is defined as pollution. This is illustrated in figure 2.3.1

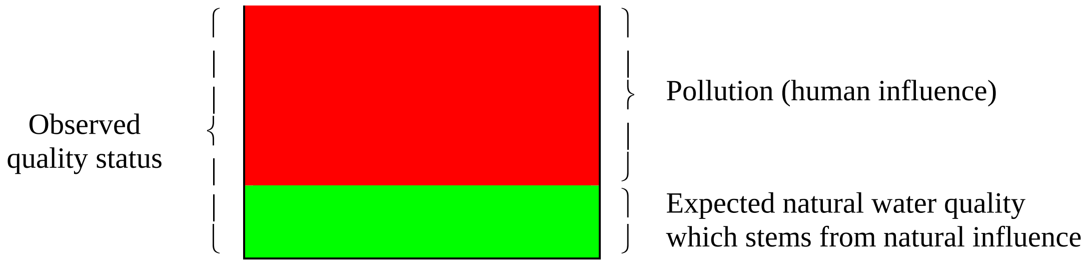


Figure 2.3.1. A measured quality status can be divided into an expected natural water quality and contributions from human activities.

The human influence on the water quality will vary a substantially, and it is important to estimate the natural water quality when the goals for the water quality are set. As an example, figure 2.3.2 shows the expected natural water quality and the observed quality status for a shallow lake in the southeastern part of Norway.

Table 2.3.2. A typical shallow lake in the south-eastern part of Norway with most of its catchment consisting of marine clay

	Quality class				
Effect categories:	**I**	**II**	**III**	**IV**	**V**
Nutrients					
Organic matter					
Acidifying components					
Micro-pollutants					
Particles					
Faecal bacteria					

Expected natural water quality

Observed quality status, when it is not identical to the expected natural water quality

The difference between the observed quality and the expected natural quality represents the pollution, and a goal for future quality should be between these two. A class II goal for particles in this lake is therefore meaningless.

The classification of suitability is based on the pollution control and health authorities evaluation of the that are appropriate for the environmental quality connected to different usage of the water i.e. for drinking water, bathing, fishing and irrigation.

2.3.2 Method and date requirements

As shown in table 2.3.3, there are 6 different effect-categories or pollution types in the system. Each of these effect categories has a number of parameters to describe the pollution types. Parameters in italic are so-called key parameters. The sampling frequency and calculation methods to be used to get the classification value are also provided. Each of the effect categories should be estimated. A general pollution class should not be elaborated, but each of the effect-categories should be treated separately. Some parameters, which are commonly studied, but not classified in this system, are included in the table in brackets.

Table 2.3.3. Requirements for classification of each of the effect categories.

Effect categories:	Ecosystem -type	Parameters	Sampling frequency	Calculation method
Nutrients	Lakes	*Total phosphorus* *Chlorophyll a* *Secchi depth* Primary production Total nitrogen (Orthophosphate)¤ (Phytoplankton) (Zooplankton)	At least monthly. Mixed sample, May-October. Deep-profile (3-5 samples) late-summer and late-winter	Arithmetic mean.
	Rivers	*Total phosphorus* Total nitrogen (Periphyton) (benthic fauna)	At least monthly.	Arithmetic or time-weighted mean.
Organic matter	Lakes	*TOC* *Colour* *Oxygen* *Secchi depth* COD Fe Mn	Deep-profile (3-5 samples) in spring, late summer, fall and late winter.	Arithmetic mean. Oxygen: lowest value Fe and Mn: highest values
	Rivers	*TOC* COD (Periphyton) (Benthic fauna)	At least monthly [#]	Arithmetic or time-weighted mean.
Acidifying components	Lakes and rivers	*Alkalinity* *pH* (Benthic fauna)	Spring, summer, fall and winter in lakes. Monthly in rivers.	Lowest value.
Micro pollutants (heavy metals)	Lakes and rivers	Dependent on problematic component(s)	Spring, summer, fall and winter in lakes. Monthly in rivers	Highest value
Particles	Lakes and rivers	*Turbidity* *Suspended matter* *Secchi depth (in lakes)*	At least monthly.	Arithmetic or time-weighted mean.
Faecal bacteria	Lakes and rivers	*Thermotolerant coliform bacteria*	At least monthly.* Deep-profile (3-5 samples)	Highest 90-percentile.

[#] More frequent sampling in small rivers.
* If drinking or bathing interests (bathing season) prevail, weekly sampling may be necessary (ref. regulations for drinking water and bathing water).
¤ Measured in smaller rivers and in deep-profile in lakes.

2.3.3 Classification of environmental quality

The basis for the division of parameters into quality classes is a combination of statistical information about the distribution of the substances in Norwegian watercourses, and knowledge about the substances' effects on the ecology in the water environment.

Tables 2.3.4 and 2.3.5 show the classification of the *quality status*. The key parameters are listed in *italics*.

Table 2.3.4. Classification of the quality status for nutrients, organic matter, acidifying components, particles and faecal bacteria.

Effect categories:	Parameters	Quality class I "Very good"	II "Good"	III "Fair"	IV "Bad"	V "Very bad"
Nutrients	*Total phosphorus*, µg P/l	<7	7-11	11-20	20-50	>50
	Chlorophyll a, µg/l	<2	2-4	4-8	8-20	>20
	Secchi, m	>6	4-6	2-4	1-2	<1
	Prim.prod., g C/m^2 Y	<25	25-50	50-90	90-150	>150
	Total nitrogen, µg/l	<300	300-400	400-600	600-1200	>1200
Organic Matter	*TOC*, mg C/l	<2,5	2,5-3,5	3,5-6,5	6,5-15	>15
	Colour, mg Pt/l	<15	15-25	25-40	40-80	>80
	Oxygen, mg O_2/l	>9	6,4-9	4-6,4	2-4	<2
	Oxygen, %	>80	50-80	30-50	15-30	<15
	Secchi, m	>6	4-6	2-4	1-2	<1
	COD_{Mn}, mg O/l	<2,5	2,5-3,5	3,5-6,5	6,5-15	>15
	Iron, µg Fe/l	<50	50-100	100-300	300-600	>600
	Manganese, µg Mn/l	<20	20-50	50-100	100-150	>150
Acidifying Components	*Alkalinity*, mmol/l	>0,2	0,05-0,2	0,01-0,05	<0,01	0,00
	pH	>6,5	6,0-6,5	5,5-6,0	5,0-5,5	<5,0
Particles	*Turbidity*, FTU	<0,5	0,5-1	1-2	2-5	>5
	Susp. matter, mg/l	<1,5	1,5-3	3-5	5-10	>10
	Secchi, m	>6	4-6	2-4	1-2	<1
Faecal bacteria	*Thermotol. coli. bact.*, num./100 ml	<5	5-50	50-200	200-1000	>1000

For the micro-pollutants, there is established a so-called "high diffuse background level", based on a large statistical material. This background level is slightly higher than the mean value, about the 75-90 percentile. This value represents the limit between classes I and II. The classes II-V area is based an upscaling of the background level after an assessment of the different substances as to:

- how hazardous each of them is
- if they are observed in low or high concentrations in the watercourses
- how large a change in concentration a given effluent entails
- health risk (only for mercury in fish)

In class IV or V there is usually known effects from the substances on one or several elements in the ecosystem. This will, however, vary a great deal because of variable bioavailability. This varies according to the content of organic- and particular matter, conductivity and pH.

Table 2.3.5. Classification of the quality status for micro-pollutants in water, sediment and fish. The quantity in sediments is measured as mg substance pr. kg sediment (dry-weight), and mercury in fish as mg Hg/kg muscle (wet-weight).

Effects of micro-pollutants (heavy metals)	**Parameters**	**Quality class**				
		I "Slightly polluted"	**II "Moderately polluted"**	**III "Markedly polluted"**	**IV "Severely polluted"**	**V "Extremely polluted"**
in water	Copper, µg Cu/l	<0,6	0,6-1,5	1,5-3	3-6	>6
	Zinc, µg Zn/l	<5	5-20	20-50	50-100	>100
	Cadmium, µg Cd/l	<0,04	0,04-0,1	0,1-0,2	0,2-0,4	>0,4
	Lead, µg Pb/l	<0,5	0,5-1,2	1,2-2,5	2,5-5	>5
	Nickel, µg Ni/l	<0,5	0,5-2,5	2,5-5	5-10	>10
	Chromium, µg Cr/l	<0,2	0,2-2,5	2,5-10	10-50	>50
	Mercury, µg Hg/l	<0,002	0,002-0,005	0,005-0,01	0,01-0,02	>0,02
in sediment	Copper, mg Cu/kg	<30	30-150	150-600	600-1800	>1800
	Zinc, mg Zn/kg	<150	150-750	750-3000	3000-9000	>9000
	Cadmium, mg Cd/kg	<0,5	0,5-2,5	2,5-10	10-20	>20
	Lead, mg Pb/kg	<50	50-250	250-1000	1000-3000	>3000
	Nickel, mg Ni/kg	<50	50-250	250-1000	1000-3000	>3000
	Arsene, mg As/kg	<5	5-25	25-100	100-200	>200
	Mercury, mg Hg/kg	<0,15	0,15-0,6	0,6-1,5	1,5-3	>3
in fish	Mercury, mg Hg/kg	<0,2	0,2-0,5	0,5-1	1-2	>2

2.3.4 Biodiversity

Freshwater species have different tolerance to different environmental impacts. For instance will different species of benthic fauna react differently to acidification. Some species will have large problems with reproduction even if the acidification is not very strong. The general picture is that the number of species will drop when the environmental stress is enhanced. Table 2.3.6 shows how indicator species have different tolerance to acidification.

Table 2.3.6. Schematic view of some common benthic species in Norwegian freshwater fauna and their tolerance to acidity

Quality class		**V**		**IV**	**III**	**II-I**
pH - interval		**< 4,5**	**4,5 - 5,0**	**5,0 - 5,5**	**5,5 - 6.0**	**¤ 6,0**
Leuctra hippopus	Stonefly	●	●	●	●	●
Amphinemura sulcicollis	"	●	●	●	●	●
Rhyacophila nubila	Caddisfly	●	●	●	●	●
Polycentropus flavomaculatus	"	●	●	●	●	●
Leptophlebia spp.	Mayfly	●	●	●	●	●
Isoperla spp.	Stonefly		●	●	●	●
Brachyptera risi	"		●	●	●	●
Hydropsyche siltalai	Caddisfly		●	●	●	●
Pisidium spp	Mollusc		●	●	●	●
Ameletus inopinatus	Stonefly			●	●	●
Heptagenia sulphurea	Mayfly			●	●	●
Diura nanseni	Stonefly			●	●	●
Capnia atra/pygmea	"			●	●	●
Lymnea peregra	Snail				●	●
Gyraulus acronicus	"				●	●
Gammarus lacustris	Crustacea				●	●
Baetis spp.	Mayfly				●	●
Ephemeralla aurivillii	"				●	●
Caenis spp.	"				●	●

2.3.5 Suitability for drinking water (raw water)

"Raw water" means the untreated water in the watercourse, surface or ground water. The suitability of raw water is linked to the treatment undertaken before delivered to the consumer. A relatively bad raw water quality can, if appropriate technology is applied, result in a very good tap water quality. In Norway, unlike the continental Europe, most of the drinking water plants have a low degree of treatment. The raw water quality is therefore associated with simple treatment (fine screening, disinfecting and possible pH adjustment).

Table 2.3. classifies the most important parameters describing the quality of raw water. The health authority issued a drinking water provision in 1995, based on a number of EU Directives. In this provision, a number of other parameters is included, i.a. micro-pollutants. In most watercourses in Norway these requirements are easy to meet, and potential water sources with, i.a., heavy metals can be avoided.

Table 2.3.7. Evaluation of raw water quality, key parameters. 'No values' mean that there are no meaningful values.

Drinking water - crude water		Suitability class			
Effects of:	Parameters	1 Well suitable	2 Suitable	3 Less suitable	4 Unsuitable
Faecal bacteria	Thermotol. coli. bact., num./100 ml	0*	0**	-	>0***
Organic Matter	Colour, mg Pt/l	< 20	< 20	-	> 20
	Iron, µg Fe/l	< 50	50 - 200	-	> 200
	Manganese, µg Mn/l	<20	20 - 50	-	> 50
	Oxygen, %	>70	<70	-	-
Physical-Chemical parameters	pH	7,5 - 8,5	6,5 - 8,5	< 6,5 /> 8,5	-
	Turbidity, FTU	<0.4	0,4 - 4	-	>4

* 90 % of the samples must meet the requirements, others must be in the range 0-10 TCB/100 ml

** Waterworks supplying > 10.000 persons, a minimum of 70% of the samples must meet the table value, waterworks supplying > 1.000 persons, a minimum of 60% of the samples must meet the table value, and for waterworks supplying > 100 persons, a minimum of 50% of the samples must meet the table value. The rest of the samples must be in the range of 0-10 TCB/100 ml.

*** Less than 50% of the samples must meet the table value, or single samples concentrations are higher than 10 TCB/100 ml

Water in suitability class 4 is unsuited for simple treatment, but can provide good tap-water quality if extensive physical and chemical treatments are provided.

In addition to the key parameters, some eutrophication parameters should be included, mainly because of possible algal blooms in lakes, which can involve taste/odour problems and possible toxin production. The support parameters are shown in table 2.3.8.

Table 2.3.8. Evaluation of raw water quality, support parameters.

Drinking water - crude water		Suitability class			
Effects of:	Parameters	1 Well suitable	2 Suitable	3 Less suitable	4 Unsuitable
Nutrients	Total phosphorus, µg P/l	<7	7 - 11	11 - 20	>20
	Chlorophyll *a*, µg/l	<2	2 - 4	4 - 8	>8

2.3.6 Suitability for bathing and recreation

Recreation includes water-related activities in direct contact with water.

The health authorities have issued guiding standards for bathing water quality in 1994. In addition to the health aspects, the criteria published include conditions associated with peoples well-being and aesthetics (Tables 2.3.9 and 2.3.10).

Table 2.3.9. Evaluation of water quality for bathing and recreation, key parameters.

Bathing and recreation		Suitability class			
Effects of:	Parameters	1 Well suitable	2 Suitable	3 Less suitable	4 Unsuitable
Faecal bacteria	Thermotol. coli. bact., num./100 ml	<100	<100	100 - 1000	>1000
	Faecal streptococci num./100 ml	<30	<30	30 - 300	>300
Physical-chemical parameters	pH	5,0 - 9,0	<5,0 / >9,0	-	-
	Turbidity, FTU	<1	1 - 2	2 - 5	>5

The water samples must be taken at the place where people regularly bathe, at least 1 m depth, and min. 2-3 m from the shore.

The support parameters in table 2.3.10 are included for the same reason as for drinking water, i.e. algal blooms. They are usually sampled at the deepest point of the lake.

Table 2.3.10. Evaluation of water quality for bathing and recreation, support parameters.

Bathing and recreation		Suitability class			
Effects of:	Parameters	1 Well suitable	2 Suitable	3 Less suitable	4 Unsuitable
Nutrients	Total phosphorus, µg P/l	<7	7 - 11	11 - 20	>20
	Chlorophyll *a*, µg/l	<2	2 - 4	4 - 8	>8
	Secchi depth, m	>4	2-4	1 - 2	<1
Organic matter	Colour, mg Pt/l	< 25	> 25	-	-

Other conditions of relevance could be:

- Water temperature
- Sun and wind conditions, currents
- Shore and bottom conditions
- Floating objects and garbage
- Algae and parasites (*Gonyostomum*, cercarie-larvae)
- Macro-vegetation, such as water lilies

2.3.7 Suitability for fishing (recreational)

The basis for this classification is the environmental requirement for reproduction of Salmonoid fish (red fish) and the animals they feed upon. An exception from this is mercury in fish , where the health aspects are the most important (Table 2.3.11).

Table 2.3.11. Evaluation of water quality for recreational fishing.

Fishing (recreational)		Suitability class			
Effects of:	Parameters	1 Well suitable	2 Suitable	3 Less suitable	4 Unsuitable
Organic matter	Oxygen (surface), % Oxygen (deep-w.), %	80 - 110 >70	110 - 130 30 - 70	130 - 160 15 - 30	>160 <15
Acidifying components	pH* Alkalinity, mmol/l	6,0 - 8,5 >0,05	5,5 - 6,0 0,05 - 0,01	5,0 - 5,5 <0,01	<5,0 0
Micro-pollutants (heavy metals)	Mercury in fish mg/kg (fillet, freshweight)	<0,2	0,2 - 0,5	0,5 - 1,0	>1,0
Nutrients**	Total phosphorous, µg P/l Chlorophyll *a*, µg/l Secchi, m	<11 <4 >4	11 - 20 4 - 8 2 - 4	20 - 50 8 - 20 1 - 2	>50 >20 <1

*the effect is dependent upon the conc. of Ca, TOC and labile Al.
**applies for where red fish is spawning

Class 1: Well suitable
The water quality creates no problem for organisms eaten by fish, it represents no health risk eating the fish. The quality of the fish is good.

Class 2: Suitable
The water quality can create some problems for the most important animals which Salmonoid fish feed upon, e.g. *Gammarus lacustris.* The fish fauna itself is often not affected, apart from the quality of the fish which can be somewhat reduced.

Class 3: Less suitable
The water quality can be a significant stress factor, especially for Salmonoid fish. Among other things, the reproduction and breeding areas can be suffering. Odour, taste and elevated content of micro-pollutants in the fish fillet can appear.

Class 4: Unsuitable
Salmonoid fish have difficulties to live and breed. The water quality is critical also for other fish species, such as white fish. In highly eutrophic waters, many of the fish species are unsuitable for human consumption. Odour, taste and elevated content of micro-pollutants in the fish fillet are common. Parasites and diseases can occur.

2.3.8 Suitability for irrigation

The water quality criteria for irrigation are based on proposals from a working group under the agricultural authorities. In addition to the proposed criteria connected to bacteria, some eutrophication parameters are included.

The plants are divided into three categories:

I. Fruit, berry, lettuce, Chinese cabbage, cauliflower, broccoli, carrot and other types of vegetables which are eaten raw and without peeling.

II. Plants that are peeled or heat-treated before eating e.g. potato, common cabbage, onion and fodder plants, which are not dried or ensilaged.

III. Cereal or leguminous plants and fodder plants, which are dried or ensilaged, as well as plants in sports and park installations.

Table 2.3.12. Evaluation of the water quality for irrigation.

Irrigation		Suitability class			
Effects of:	Parameters	1 Well suitable	2 Suitable	3 Less suitable	4 Unsuitable
Nutrients	Total phosphorous, µg P/l Chlorophyll *a*, µg/l	<11 <4	11 - 20 4 - 8	20 - 50 8 - 20	>50 >20
Faecal bacteria	Thermotol. Coli. bact., num./100 ml	<2	2 - 20	20 - 100#	>100#
	Coliform bact. num./100 ml	<20	20 - 200	200 - 1000#	>1000#

For plants in category III, values up to 150 thermotol. coli. bact. and 1500 coliform bact. are tolerated.

Class 1: Well suitable
The water can be used for all types of plants until the day of harvesting.

Class 2: Suitable
The water can be used for plants in category I until two weeks before harvesting, or until harvesting, if drip-watering is applied. It can be used without restrictions on other types of plants.

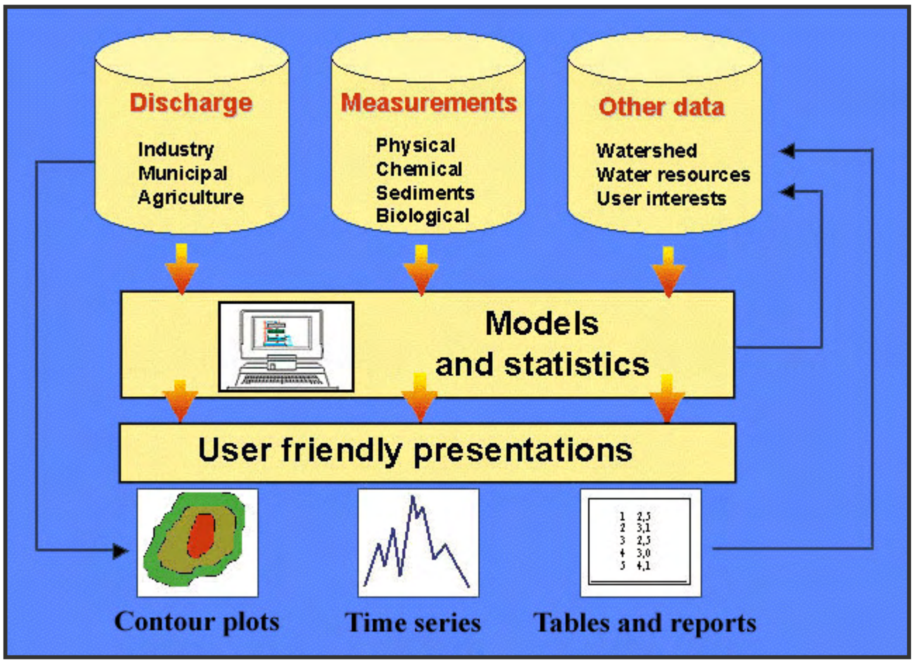
Class 3: Less suitable
The water should not be used for plants in category I. It can be used for plants in category II until two weeks before harvesting. It can be used for plants in category III without restrictions (for plants in category III, values up to 150 Thermotol. coli. bact. and 1500 coliform bact. are acceptable).

Class 4: Unsuitable
The water should not be used for any type of plants (for plants in category III, values up to 150 thermotol. coli. bact. and 1500 coliform bact. are acceptable).

2.4 ENSIS - *En*vironmental *S*urveillance and *I*nformation *S*ystem

ENSIS is a management and decision support system for environmental issues. ENSIS provides a geographical information system interface for the integration and display of air and water quality monitoring and modelling results. The system can be used as a management tool for planners, an information tool for the public and an expert system for specialists. ENSIS WaterQUIS is the part of ENSIS dealing specifically with water resources.

General features
ENSIS is an environmental surveillance and information system that includes ENSIS Basic, AirQUIS, CorrCost, ADACS (Automatic Data ACquisition System) and WaterQUIS. The system consists of a database, which is integrated with models and a graphical user interface. These parts are explained in the following sections while interactions between them are outlined in the figure below. Institutions dealing with water research (NIVA), air research (NILU) and geographical information systems (NORGIT) have jointly developed ENSIS.



The user interface
The user interface is based on a geographical information system (GIS) from which geographically linked objects such as pollution sources, monitoring stations, measurements, and model results can be presented. The map interface can also be used to make queries to the database.

The models
The models provide the ability to identify the consequences of different planning scenarios. WaterQUIS can for instance be used as an effective tool for water pollution abatement strategies. The contribution of water pollution from different source categories, such as municipal wastewater, industry and agriculture can be calculated based on discharges. Different measures to reduce water pollution can be evaluated and then prioritised, taking into account both their costs and benefits.

The database
All data is stored in one database, offering the user a system for storing, systematising and retrieving environmental data. The use of a common database ensures consistency of the data. Data are entered into the database via standard graphical menus and special import functions.

The presentation
ENSIS consists of tools for graphical inspection and control of data, and tables for numerical presentation. The information system provides an automatic report generator and access to environmental classification systems.

WaterQUIS features
- Geographical definition of watershed and watershed hierarchy
- Storage and presentation of watershed information
- Geographical definitions of rivers, lakes and marine areas to be used as objects for storage and presentation of water resources
- Creation an inventory of discharges, consisting both of point and non-point pollution sources, such as municipal waste water, industry and agriculture
- Data collection, storage and presentation of monitored data on physical, chemical, biological and sedimentological conditions
- Water quality and quantity models, integrated with the database and the GIS interface.

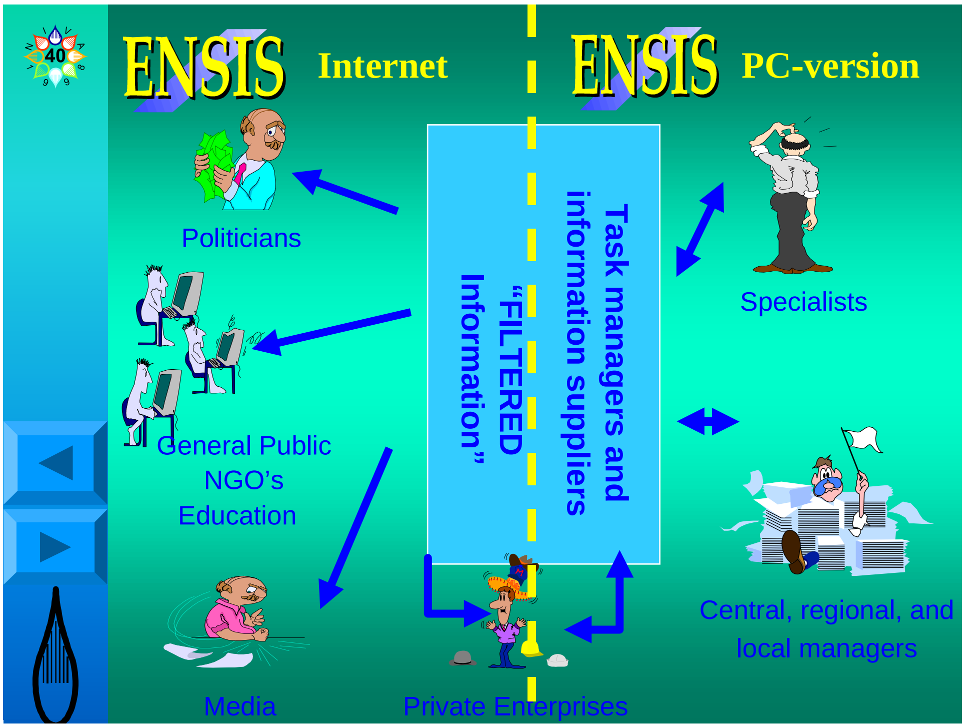
Advantages of WaterQUIS
- Increased availability of information, providing a better basis for decision-making by planners and politicians
- Improved information access to the public, thereby increasing their awareness of environmental issues and involvement in planning processes
- Increased use of consistent environmental data
- Improved long-term planning with the use of predictive models.

System specification
The ENSIS Software is developed for a 32-bit platform (Windows NT). ENSIS supports databases with ODBC support, but Oracle and Sybase are preferred. The database can be run on a Windows NT or a UNIX server. ENSIS 2.0 is programmed in Visual Basic and uses MapObjects as the GIS System. MapObjects is compatible with ArcView and ArcInfo.

Planned future developments
The described functionality will all be included in ENSIS 2.1, which will be ready for release in 1999. The main features are already implemented in the existing ENSIS 2.0 (1998).

An Internet version
The ENSIS-group is also preparing an Internet version of the system. The simulation is simplified compared to the specialist system, but the public will be given direct access to the ENSIS database.

System can be transferred from the expert-oriented version (right side) to the user friendly “filtered” version, available for example via Internet.



Further Information
For additional information feel free to contact:
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E-mail:	kjersti.dagestad@niva.no
Www:	http://www.niva.no/ensis/

3. List of Activities and Publications

The main activities during the development of the project are shown in table 3.1 below:

Table 3.1 The main activities of the project

NR	Activity	Period	Participants	Reference
1.	January 1996 project meeting in Warsaw	January/ February 1996	Representatives of IOS Representatives of NIVA (GAA, SSJ)	NIVA - I
2.	May 1996 project meeting in Warsaw combined with a visit of the catchment area	May 1996	Representatives of IOS Representatives of NIVA (GEN)	
3.	July 1996 project meeting in Nałęczów	July 1996	Representatives of IOS Representatives of NIVA (GAA, GEN, SAB) Representatives of the communes	NIVA - I
4.	Seminary for presentation of the results of Phase I, Nałęczów	January 1997	Representatives of IOS Representatives of NIVA (GEN) Representatives of the communes Representatives of the Steering Group	NIVA -I
5.	Seminary for the presentation of the phase II + III by IOS, Kazimierz Dolny	August 1998	Representatives of IOS Representatives of NIVA (GEN, GAA, SAB) Representatives of the communes Representatives of the Steering Group Representatives of the important/sponsoring institutes	
6.	Project meeting	July 1998	Prof. Barbara Osmulska- Mróz Visiting of the catchment/Wąwolnica (GEN, GAA)	NIVA - II
7.	Closing seminary, presentation of the Norwegian Master Plan methodology, Norwegian experiences and follow-up activities, Warsaw	September 1998	List of the participates enclosed in Appendix 6.1 (GEN, GAA)	NIVA - III NIVA - III

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

List of publications/notes:

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

- B. Osmulska-Mróz *et al.*, Programme of Sanitation and Water Protection in the Bystra River Catchment, Phase I (IOS, September 1996, in Polish)
- G. Englund, " Minutes of the meeting in Poland in July 1996", WP, (NIVA-I)
- B. Osmulska-Mróz *et al.*, Programme of Sanitation and Water Protection in the Bystra River Catchment, Phase II (IOS, December 1996, in Polish)
- G.Fr. Aasgaard, " Minutes from the seminar January 21, 1997", WP, (NIVA-I)
- G. Englund and S.A. Borgvang, Strategy for Integrated Water Supply, Wastewater Treatment and Disposal Systems for Small Communes in Poland; Phase I, Data gathering (NIVA-I, April 1997)
- B. Osmulska-Mróz *et al.*, Programme of Sanitation and Water Protection in the Bystra River Catchment, Phase III (IOS, May 1997, in Polish)
- G.Fr. Aasgaard, " Minutes from the seminar August 27-28, 1997", WP, (Appendix 6.2, this report)
- Master and Action Plans (MaAP) Concept; Wastewater Management; Norwegian Methodology Illustrated with a Case Study for the Bystra River Catchment, Poland (NIVA-II, September 1998)
- Strategy for Integrated Water Supply, Wastewater Treatment and Disposal Systems for Small Communes in Poland: Final Report (NIVA-III, September 1998)
- G.Fr. Aasgaard, " Minutes from the seminar September 18, 1998", WP, (Appendix 6.3, this report).

4. Follow-up activities

During the seminar in Warsaw, 18^{th} September 1998, the following possible activities were pointed out for the possible continuation of the co-operation:

- Based on the developed Master Plan, searching for implementation possibilities at the demonstration Bystra river catchment (in Poland):
  1) Assisted by the Eco-foundation, if Norway assigns the eco-conversion agreement,
  2) Agency for the Restructurisation and Modernisation of Agriculture (10-15 % of the implementing costs)
  3) WIOŜ - Regional Inspectorate for Environmental Protection and Water Management
- ENSIS – principles (Environmental Surveillance and Information System)
- Rural Area Management – guidelines, exchange of experiences
- Regional co-operation – exchange of experiences
- Bio-sludge production – co-operation research project
- Use of Leca – materials within solutions for water and wastewater treatment
- Further technology and knowledge transfer on the masterplanning principles.

5. References

IOS-I, Programme of sanitation and water protection in the Bystra river catchment, p. 108, 1996 (In Polish – Program gospodarki sciekowej i ochrony wód w zlewni rzeki Bystrej)

IOS-II, Programme of sanitation and water protection in the Bystra river catchment, p. 20+ Appendixes (ca.p .40), 1996 (In Polish - Program gospodarki sciekowej i ochrony wód w zlewni rzeki Bystrej)

IOS-III, Programme of sanitation and water protection in the Bystra river catchment, p 12+ Appendixes (ca. p. 200) + maps, 1997 (In Polish - Program gospodarki sciekowej i ochrony wód w zlewni rzeki Bystrej)

NIVA - I, Strategy for Integrated Water Supply, Wastewater Treatment and Disposal Systems for Small Communes in Poland; *Case study – Master and Action Plans (MaAP) for the Bystra River Catchment, Phase I, ISBN 82-577-3225-7, p. 30*, 1997

NIVA - II, Master and Action Plans Concept: Wastewater Management, *Norwegian Methodology Illustrated with a Case Study for the Bystra River Catchment, Poland, ISBN 82-577-3514-0,* p. 46, 1998

Norwegian Guidelines for Elaboration of Master Plan for Wastewater Management, SFT, ISBN 82-7655-210-2, p. 20, 1994:04 (In Norwegian – Hovedplan for avløp)

Norwegian Fresh Water Quality Criteria, SFT, 1997 SFT-guideline, ISBN 82-7655-368-0, p. 31, 97:04 (In Norwegian – Klassifisering av miljøkvalitet i ferskvann)

NIVA - Information about the ENSIS, personal communication with Kiersti Dagestad, 1998

NIVA – Privatisation of water and sewage utilities in developing countries, Presentation at NIVA, 23.09.98 by Torbjørn Damhaug

Norwegian Bureau for Statistics

6. Appendixes

6.1 Closing seminar: Programme and the List of the participants

PROGRAMME:
Seminar to discuss the results and follow-up activities of the:
"Strategy for Integrated Water Supply, Wastewater Treatment and Disposal Systems for Small Communes"
Strategia Zintegrowanych Systemów Zaopatrzenia w Wodę, Oczyszczania Ścieków i Unieszkodliwiania Odpadów w Małych Gminach w Polsce
Case Study - Master and Action Plans (MaAP) for the Bystra River Catchment
na przykładzie Planu Generalnego Gospodarki Ściekowej dla zlewni rzeki Bystrej

Date and Time: Friday 18th of September 1998, from 10:30 till approx. 15:30
Place: IBMER

AGENDA: **Godzina:**

• Master plan for wastewater management; Methodology and Case study – Bystra catchment Plan generalny (Master Plan) dla gospodarki ściekowej; Metodologia i Przykład – Zlewnia rzeki Bystrej	10:30 – 11:30
• Action plan for wastewater management; Methodology and Case study – Bystra catchment Plan przedsiewzieć dla gospodarki ściekowej; Metodologia i Przykład – Zlewnia rzeki Bystrej	11:30 – 12:00
Pause (Przerwa)	12:00 – 12:15
• Norwegian experiences relevant to the topic: (Norweskie doswiadczenia dotyczace ww tematyki:)	
- Regional co-operation (Współpraca regionalna)	12:15 – 12:45
- Rural area management (Zarządzanie obszarami wiejskimi)	12:45 – 13:15
- ENSIS – Environmental Surveillance and Information System (ENSIS – "Nadzór"/Inspekcja Środowiska i System Informacyjny)	13:15 – 13:45
Pause (Przerwa)	13:45 – 14:00
• Evaluation of the experiences from the project, by all participating partners (Ewaluacja doswiadczeń osiągnietych podczas projektu, z udziałem wszystkich uczestników projektu)	14:00 – 14:45
• Future co-operation possibilities (Mozliwosci dalszej współpracy)	
- Application oriented tasks / activities (Zadania do praktycznego zastosowania, skierowane na potrzeby użytkownika)	
- Financial possibilities (bilateral agreement, EC, Eco-conversion) (Możliwosci finansowania współpracy (umowa bilateralna, Unia Europejska, Eko-konwercja))	14:45 – 15:30
• Lunch	

LIST of the participants
of the project-meeting 18th of September 1998, in Warsaw
Master and Action Plan for the Bystra River Catchment and further co-operation

No	Name	Institution	Signature
1.	Doc. dr hab. inz. Krzysztof Wierzbicki, Dyrektor ds naukowych	Instytut Budownictwa, Mechanizacji i Elektryfikacji Rolnictwa; (IBMER)	
2.	Pelnomocnik dyrektora Doc. dr Pawel Blaszczyk,	Instytyt Ochrony Srodowiska (IOS)	
3.	Z-ca Prezesa Zarzadu M.Ba. Slawomir Skrzypek	Narodowy Fundusz Ochrony Srodowiska i Gospodarki Wodnej; (NFOSiGW)	
4.	Koordynator Mgr inz. Ewa Suszynska	NFOSiGW, Zespól Ochrony Wód	
5.	Dyr. Romuald Wojciechowski	NFOSiGW, Zespól Wspólpracy z Zagranica	
6.	Wójt inz. Marian Zaba	Przewodniczacy Stowarzyszenia Doliny Rzeki Bystrej	
7.	Burmistrz Wojciech Wójcik	Urzad Miasta w Naleczowie	
8.	Wójt Stanislaw Bednarczyk	Urzad Gminy Wojciech\ow	
9.	Burmistrz Ignacy Wlodek	Urzad Miasta w Kazimierzu Dolnym	
10.	mgr inz. Andrzej Badowski, Dyrektor	Regionalny Zarzad Gosp. Wodnej (RZGW)	
11.	Doradca Zespolu Mgr Andrzej Sniadowski	Agencja Restrukturyzacji i Modernizacji Rolnictwa	
12.	Prof. Rafal Milaszewski	Politechnika Bialostocka	
13.	Vice Dyrektor Mgr inz. Eugenia Koblak-Kalinska	Ministerstwo Ochrony Srodowiska, Zasobów Naturalnych i Lesnictwa; (MOSZNiL); Dept Ochrony Srodowiska	
14.	Dyrektor Dr inz. Mieczyslaw Ostojski	MOSZNiL Departament Wspólpracy z Zagranica	
15.	Dyrektor Dr inz. Stanislaw Garlicki	MOSZNiL Departament Ochrony Srodowiska	
16.	Dyrektor Mgr Marek Sobiecki	MOSZNiL , Dept. Polityki Ekologicznej i Integracji Europejskiej	
17.	Prezes Dr. Slawomir Janicki	Wojew. Fundusz Ochr. Srod. i Gosp. Wodnej	
18.	Mgr inz. Zdzislaw Strycharz	Urzad Wojewódzki, Wydz. Ochrony Srod.	
19.	Prezes, Prof. Maciej Nowicki	Ekofundusz	
20.	Prof. dr hab. Barbara Osmulska-Mróz	Instytyt Ochrony Srodowiska (IOS)	
21.	Dyrektor M.Sc. Gunnar Fr. Aasgaard	Avløpssambandet Nordre Øyeren (ANØ)	
22.	Mgr inz. Grazyna Englund	Norweski Instytut do Badania Wody (Norwegian Institute for Water Research; NIVA)	

6.2 Minutes from the seminar August 27-28, 1997

Statens forurensningstilsyn
Postboks 8100 Dep
0032 Oslo
Att.: Bjørg Storesund

PROSJEKT OM VANN, AVLØP OG SLAMDISPONERING I POLEN
Statusrapport og referat fra seminar i prosjektområdet 28.08.97

Utredningsdelen av prosjektet er på det nærmeste fullført. Sluttrapporten fra IOS har imidlertid vesentlige mangler i forhold til norsk planleggingspraksis, både i innhold og form. Metodiske forskjeller vil kunne synliggjøres gjennom en sammendrags-rapport, utarbeidet av NIVA og basert på SFTs veileder for hovedplan avløp. En slik rapport vil også være et tjenlig verktøy for prosjektkommunene ved implementering av foreslåtte tiltak.

Vi viser til vårt brev av 14.05.97 (219/97/64.0/Gaa) og oversender herved statusrapport fra prosjektet og referat fra seminar i Kazimierz Dolny, Polen 28.08.97.

Endelig sluttrapport vil, som det fremgår av SFTs tilsagnsbrev, bli skrevet på engelsk. Denne statusrapporten m/seminarreferat vil imidlertid bli skrevet på norsk, som forøvrig forrige interimsrapport ble det (23/97/64.0/Gaa). Norsk er benyttet fordi jeg i dette notatet vil gi noen kritiske kommentarer til prosjektet, som ikke nødvendigvis bør bli direkte oversendt til de polske prosjektdeltakere. Momentene vil imidlertid bli innarbeidet i sluttrapporten, i lys av de erfaringer vi kan trekke etter at prosjektet er avsluttet.

Prosjektstatus og videre aktiviteter

Den polske prosjektdeltakeren, IOS har nå fullført sin del av prosjektet (som de har finansiering til). I tre relativt tykke rapporter presenterer de resultatet av sine innledende undersøkelser, feltundersøkelser og forslag til tiltak. Mye grundig arbeid er nedlagt, men fra norsk side har vi vesentlige anmerkninger til såvel innhold som form.

- Innhold
  NIVA var tidlig i prosjektet nøye med å presisere viktigheten av å formulere prosjektmål ut fra lokale og regionale brukerinteresser. Dette har dessverre ikke blitt fulgt opp og IOS-rapporten er i hovedsak utformet som en tiltaksplan for generell utbygging av avløpsanlegg. Målvurdering som konsekvens av gjeldende resipientforhold er også mangelfull, spesielt er det manglende sammenheng mellom ønsket «vannkvalitetsklasse» og foreslåtte tiltak. Nytte/kostnads vurderinger er forøvrig ikke gjennomført utover rene teknisk/økonomiske vurderinger. Tverrsektorielle vurderinger (vann - avløp - slam - avfall - jordbruk) er ikke foretatt.

- Form
  Rapportene fra IOS er svært detaljerte og - etter norske forhold - lite strukturerte. Når vi samtidig vet at de berørte kommuner stort sett ikke har teknisk fagpersonell i sin administrasjon, vil det bli tungt å benytte rapportene til videre oppfølging av de foreslåtte tiltakene.

Noen av ovennevnte mangler ble diskutert og avhjulpet under og etter seminaret i august, gjennom en direkte dialog mellom polske problemeiere/beslutningstakere og NIVA/ANØ. Mål ble konkretisert og forhold til andre sektorer (utover avløpssektoren) ble avklart. Samtidig ble det besluttet at NIVA skulle utarbeide et konsentrat av prosjektrapporten, inklusive de suppleringer som ble foretatt på seminaret. Malen for denne kortversjonen skulle i hovedsak være *Plandokument etter plannivå 1* (politikere som målgruppe), slik dette er beskrevet i SFTs veiledning 94:04 (Hovedplan for avløp).

Gjennom utarbeidelse av en slik sammendragsrapport *(Master and Action Plan)* vil man kunne oppnå følgende:

- Presentere en målrettet, tiltaksorientert og forståelig (brukervennlig) rapport som både politikere og administrasjon vil få god nytte av. Detaljer kan studeres i IOS-rapporten.
- Rapporten vil være et godt - og nødvendig - supplement til IOS-rapporten
- Rapporten vil sette fokus på de essensielle momentene; rammebetingelser, tilstands- og situasjonsbeskrivelse (uten å gå i detaljer), mål og resultatområder, valg av hovedløsninger (herunder nytte- og kostnadsvurderinger) samt handlingsplan
- En helhetlig vurdering av vann, avløp, slam, avfall og landbruk kan gjøres i rapporten, selv om malen (SFT 94:04) i utgangspunktet gjelder avløpssektoren. Denne vurderingen må imidlertid gjøres relativt overfladisk på grunn av mangelfullt datagrunnlag
- NIVA må hente mye bakgrunnsinformasjon fra IOS for å kunne trekke og presentere konklusjoner. Eventuelle mangler i IOS' arbeid vil ved dette bli avdekket, og vil forhåpentligvis kunne rettes opp før prosjektet avsluttes
- Kommentarer om norsk/polsk praksis kan legges inn, f.eks. i fotnoter eller i spesielle tekstfelt. Den pedagogiske effekten (kunnskaps- og erfaringsoverføring mellom Norge og Polen) vil være god når slike kommentarer knyttes direkte til faktiske vurderinger i et konkret prosjektområde.

I tillegg til utarbeidelse av ovennevnte *Master and Action Plan*, med politikere som målgruppe, vil prosjektet fra NIVAs side bli videreført som beskrevet i instituttets prosjektsøknad.

Min funksjon som medlem av prosjektets styringsgruppe bør i sluttfasen konsentrere seg om oppfølging av NIVAs arbeid, inkludert avstemming av dette mot forventninger og aktiviteter i Polen, samt deltakelse i et eventuelt avslutningsmøte i Polen. ANØ vil om kort tid oversende egen søknad om dette.

Seminar i Kazimierz Dolny 28.08.97

Seminaret ble noe begrenset i forhold til opprinnelige planer, men 30-40 engasjerte personer hørte interessert på innleggene og tok del i diskusjonene. Fra norsk side deltok Grazyna Englund og Stig A. Borgvang, begge NIVA samt undertegnede. Programmet var lagt opp slik:

1. Åpning ved formannen i styringsgruppen, professor Krzysztof Wierzbicki
2. Prosjekt- og resultatgjennomgang ved IOS
3. Kommentarer på prosjektgjennomføring og resultater ved NIVA (Borgvang)
4. Forberedte kommentarer fra 3 seminardeltakere
5. Diskusjon
6. Videreføring av prosjektet (Englund)
7. Oppsummering/avslutning

Innleggene og etterfølgende diskusjoner ble konsentrert om følgende hovedpunkter:

- Avklaringer og synspunkter på forslag til tiltak og underlaget for disse
- Nyansering og presisering av mål, spesielt relatert til identifiserte brukerinteresser og konsekvenser for krav (omfang) til tiltak
- Nytten med en politikerorientert sammendragsrapport
- Muligheter for finansiering av tiltak

- Videre aktiviteter

Det var stor interesse, både lokalt og regionalt, for at NIVA utarbeidet en sammendragsrapport som nevnt over. En slik rapport vil også være et godt utgangspunkt for kompetansespredning, for eksempel ved å arrangere seminarer om hovedplanarbeid i små og mellomstore kommuner i Polen.

Finansiering av aktuelle tiltak er ennå ikke avklart, men Ms Maria Apolinarska fra *National Fund for Environmental Protection and Water Management*, Warszawa uttrykte vilje til å prioritere disse kommunene. Tilgjengelige midler er imidlertid begrenset som følge av den store flommen Polen ble rammet av i 1997.

Med vennlig hilsen
AVLØPSSAMBANDET NORDRE ØYEREN

Gunnar Fr. Aasgaard

Kopi sendt: NIVA v/Grazyna Englund

6.3 Minutes from the seminar September 18, 1998

Minutes from the closing seminary at IBMER, Warsaw 18.09.98

The objective of the closing seminar was to discuss the results and posible follow-up activities for the bilateral projeject *Strategy for Integrated Water Supply, Wastewater Treatment and Disposal Systems for Small Communes*.

Date and time	:	Friday 18. September 1998, 10.30 - 15.30
Place	:	IBMER, Warsaw
Participants	:	22 persons (see enclosed list of participants)

The chairman of the steering committee for the project, Prof. dr. Krzysztof Wierzbicki opened the seminary. Ms. Grazyna B. Englund, NIVA; the Norwegian project leader, chaired the seminar.

1. Master Plan for Wastewater Management; Methodology and Case Study - Bystra Catchment (Mr. Gunnar Fr. Aasgaard, Norway)

The methodology presented was based on the Norwegian guidelines for developing Master Plans for wastewater management. Emphasis was made on identified differences between Norwegian and Polish practices.

Based on general discussions within the project, and in the seminary in particular, some recommendations were made for the forthcoming process as regards sanitation in the four Bystra communes, with regard to the implementing of the proposed measures. The main recommendations are:

➔ *To continue the monitoring of the water quality in the Bystra river, including to take some flow proportional samples. This will make it easier to develop a mass balance budget in the catchment for phosphorus, organic matter and other relevant parameters. Such a mass balance is necessary in order to estimate the benefits of future measures.*
➔ *To perform a cost-effective analysis before deciding on centralised or decentralised wastewater solutions.*
➔ *To prepare the wastewater treatment plants for chemical precipitation, to be implemented at a later stage, in order to reduce the eutrophication of the Bystra river.*
➔ *To evaluate centralised sludge treatment at the Nalêczów wastewater treatment plant, using a filter press for dewatering and lime stabilisation, for further use as fertliser.*
➔ *To establish one central operational unit to operate and manage the wastewater treatment plants in the Bystra catchment, including the sewerage systems.*
➔ *To design and implement an environmental surveillance programme, and to present the results in the Annual Report for the wastewater sector.*
➔ *To design and implement a tariff structure based on «full cost recovery».*
➔ *Combined treatment with the industrial wastewater should be evaluated, when planning the new central and local wastewater treatment plants.*
➔ *The process in Wawolnica, trying to motivate the farmers to aggregate their farms*

into larger units, should be continued, and the other three communes should define a strategy to reduce the pollution from agricultural activities.

2. Action Plan for Wastewater Management (Mr. Gunnar Fr. Aasgaard, Norway)

The methodology presented was based on the Norwegian guidelines, with emphasis on procedure for cost-effective analysis, as a tool for prioritising of proposed measures.

Some measures have already been implemented in the Bystra catchment, as explained by representatives from the communes. The main part of the proposed measures, however, has so far no funding, and it may take some time to allocate the needed financial resources.

In this situation, the strategy for the communes should be to split the proposed measure concept (IOS; Alternativ 2) into individual measures. Measures which are functional or logical dependent on each other (i.e. sewerage system and wastewater treatment plant in the same area) should be defined as *one* measure.

A cost-effectiveness analysis should be performed for each measure, and the measure(s) with the highest score should be implemented first. In this prioritising procedure, also other parameters than the defined «benefits» might be evaluated, for adjustments of the prioritised list of measures.

An example from a Norwegian Action Plan (Lillehammer, Norway) was presented as an illustration of the procedure used.

3. Norwegian Experiences relevant to the project (Mr. Gunnar Fr. Aasgaard)

To obtain cost-effective solutions, the municipalities are encouraged to co-operate in setting water quality objectives for the regional water resources, and in planning/implementing measures to reach these objectives.

Several municipalities in Norway have established co-operation with water supply, wastewater and waste management companies. The benefits from such co-operation is expected to increase as the tasks get more complicated and more resources are required.

Brief presentations were made on regional co-operation in the Romerike region, east of Oslo, Norway:

- Water supply (2 municipalities and the new Oslo Airport)
- Wastewater management (13 municipalities)
- Waste management (4 municipalities)

4. Evaluation of the experiences from the project

The participants in the seminar agreed in the general that the project had been beneficial for the participating partners. Unfortunate incidents at NIVA had made the progress less satisfactory, but this was accepted as «force majeure» and nothing could have been done differently.

The difference in planning methodology in Poland and Norway could have constituted a very interesting basis for creative discussions during the project. The different progress in developing the project, respectively from IOS and NIVA has however, made this difficult, and in some situations lead to some misunderstandings.

The main conclusion was drawn by Vice director Eugenia Koblak-Kalinska, Ministry of Environmental Protection, Natural Resources and Forestry, who confirmed that an illustration of the Norwegian methodology for Master Plans was very interesting for Poland. She indicated that developing Polish guidelines, based on the experiences from the project, might be an interesting follow-up activity.

5. Future co-operation possibilities (Ms. Grazyna B. Englund, Norway)

Several potential follow-up activities were proposed. Special interest was noted for the following ideas:

- Implementing of an environmental surveillance and information system
- Developing guidelines for Rural Area Management
- Developing guidelines for Master and Action Plans for the wastewater sector (see above)

In general, the common opinion was that all the ideas were positive, but there were currently very little money available for funding such bi-lateral projects. A mutual challenge would therefore be to do some «financial engineering», in order to establish new, beneficial environmental projects between Poland and Norway.