O-920961

WATER POLLUTION ABATEMENT PROGRAMME

THE CZECH REPUBLIC

PROJECT 3.1

Environmental Impact Analysis of the Odra River Catchment

Project Report for Phase I and

Programme of Work for Phase II

NIVA - REPORT

Norwegian Institute for Water Research NIVA

Report No.:	Sub-No.:
O-920961	
Serial No.:	Limited distrib.:
2834	Open

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Report Title:

Water pollution abatement programme. The Czech Republic.

Project 3.1. Environmental impact analysis of the Odra River catchment. Project report for Phase I and programme of work for Phase II.

Date:	Printed:
January 1993	NIVA 1993

Topic group: International activities

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Geographical area: Ostrava. Czech Republic

Pages:	Edition:
47	50

Contractor: The Norwegian Ministry of Environment

Contractors ref. (or NTNF-No.):

Abstract:

The Odra River basin in the Czech Republic is heavily polluted by discharges of waste water from industries, muncipalities and agriculture. The level of waste water treatment is low. Due to discharges of nutrients, organic matter, heavy metals and micro pollutants the ambient water quality does not meet Czech water quality standards. The report outlines the environmental problems in the region, assesses the existing environmental data and specifies needed data to develop a water pollution abatement plan for the catchment area. A detailed programme of work for Phase II of the project is elaborated. The report has been prepared jointly by Czech and Norwegian scientists.

4 keywords, Norwegian

1. Tiltaksanalyse
2. Vannforurensning
3. Tilførsler
4. Odra, Tsjekkiske republikk

4 keywords, English

1. Abatement analysis
2. Water pollution
3. Input of pollutants
4. Odra River, the Czech Republic

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ISBN-82-577-2233-2

NORWEGIAN INSTITUTE FOR WATER RESEARCH (NIVA)

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Project 3.1

ENVIRONMENTAL IMPACT ANALYSIS OF THE ODRA RIVER CATCHMENT

Project Report for Phase I and Programme of Work for Phase II

Oslo, Norway
January 1993

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Preface

The Governments of Norway and Czech and Slovak Federal Republic have signed a bilateral environmental protection agreement. As part of this agreement several collaborative projects have been identified. The permanent Norwegian - Czechoslovak working group for the protection of the environment has discussed these projects and decided to contract Norwegian Institute for Water Research (NIVA) in co-operation with the Water Research Institute Prague (WRI) and the Institute of Industrial Landscape Ecology (IILE), Ostrava to execute several project under programme area "Abatement strategies in the River Odra catchment".

One of the projects is "Environmental Impact Analysis of the Odra Catchment Area". The project proposal was developed jointly by NIVA, WRI and IILE. Under a mission to the Ostrava region in April 1992 the project proposal was discussed and it was agreed that NIVA should prepare the first draft of the joint report. The objective of this report is to assess the available information and to propose further studies in the region where needed. NIVA undertook another mission to the Ostrava region in September 1992. During this mission the project was further discussed and as part of the study water quality sampling of some of the major water courses in the region was undertaken.

As part of the project a group of scientists from the Czech Republic visited Norway in October 1992 to elaborate the programme of work further. This report presents some preliminary findings and includes a proposal for a work programme to be executed in 1993 and 1994.

The report has been prepared by Hans Olav Ibrekk, Hans Holtan and Rolf Tore Arnesen from NIVA and Jiri Svrcula from the Water Research Institute - Ostrava branch , Petr Brezina from Povodi Odry, and Alexander Skacel, Institute of Industrial Landscape Ecology (IILE).

We hope that this report outlines sufficiently some of the water quality and management problems in the region.

Oslo, January 1993

Hans Olav Ibrekk
Research Manager

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0. SUMMARY

The Odra River Basin in the Czech Republic has a total area of 6,400 km^2, which constitutes 5.5% of the total catchment area of the Oder/Odra River. Oder/Odra River has a total length of 854 km and a catchment area of 118,900 km^2. In the Czech Republic the catchment area extends in the Northern Moravia region and a small part in the Bohemia region. The length of Odra river in the Czech Republic is 120.1 km.

In the Czech part of the river basin the number of inhabitants is 1.4 million, which gives a population density of 224/km^2. Approximately 1 million inhabitants live in urban areas.

The industry in the Ostrava region is dominated by coal mines and metallurgical and chemical plants as well as pulp and paper mills.

The objective of the phase I of the project 3.1 "Environmental impact analysis of the Odra River catchment" is to;

- to organise the study team - including meetings, discussion, surveys in the Czech Republic and Norway;
- to assess already existing data concerning Environmental Impact Assessment;
- to analyse the ecological situation in the Odra River Basin; and
- to specify parameters and data which are not available in the Czech Republic and establish monitoring programmes to collect needed data.

As part of the project two missions to the Czech Republic and one mission to Norway (Czech members of the study team) have been executed. The primary focus of the study in 1992 was to collect and review background information on the environmental situation in the Ostrava region in the Czech Republic.

The environmental situation in the Ostrava region is severe. Most watercourses are heavily polluted by discharges of pollutants from industrial, municipal and agricultural sources. The level of treatment is low. The pollution causes considerable impacts on ecology and human health.

Several studies are addressing the environmental problems in the Ostrava region. Of particular relevance is the regional environmental programme in Northern Moravia - "Project Silesia". This project is an important source of information and data on pollution sources, however, there are no major overlaps between this project and Project Silesia.

Based on the initial review the pollution load to water courses is significantly higher than the previous reported figures. In phase II of the project a more detailed pollution budget will be prepared.

The proposed programme of work for phase II of the project has been prepared in detail in co-operation with WRI-O and IILE. The programme is based on the information presented in this report.

The objective of the study (phase II) is to develop planning tools for the elaboration of an optimal strategy for cost-effective water pollution abatement in the Odra River catchment area. The strategy will be based on a ranking of the most important sources to water pollution, i.e. pollution hot-spots in the region.

The strategy will form the basis for the development of a priority water pollution action programme for the Ostrava region. The action programme will focus on solving the most important local water pollution problems.

The objective is further to determine the total costs for the action programme. The cost estimates will be based on crude calculations of investment and O&M costs.

Another important aspect of the proposed study is the transfer of knowledge and methods between Czech and Norwegian scientists.

The long-term objective of the study is to prepare an environmental action programme for the region which can contribute to decisive reduction of emissions in order to restore the water courses to a sound ecological balance.

1. BACKGROUND AND RELATED STUDIES

Surface waters as well as ground waters in the Odra River catchment are heavily polluted, especially in the Ostrava industrial region and its surroundings. In its catchment area there are several districts suffering from severe water pollution, e.g. Biocel, Ostrava, Opava, Tinec, caused by industrial effluents, overloaded treatment plants and discharges from agriculture. The level of treatment is in general low and most of the existing treatment plants are heavily overloaded.

The high level of pollution cause considerable impacts on human health and ecology. There is a definite need to develop sound abatement strategies to achieve long term objectives of reducing the deterioration of the environment in the region and to restore the ecological balance in the surface waters in the region.

1.1 Baltic Sea Environment Programme

On September 3, 1990 in Ronneby, Sweden the Baltic Sea Declaration on the Environment was adopted by the Heads of Government of the Baltic Sea States. The Czech Republic is an endorsing party to the Declaration. The Declaration expresses the firm determination of the parties to:

> "Assure the ecological restoration of the Baltic Sea, ensuring the possibility of self-restoration of the marine environment and preservation of the ecological balance."

Further, the Declaration calls for the endorsing parties to:

> "Urgently prepare a joint comprehensive programme for decisive reduction of emissions in order to restore the Baltic Sea to a sound ecological balance. The programme shall be based on concrete national plans provided by the countries concerned."

In order to achieve its objectives the Declaration calls for the establishment of a High Level Ad Hoc Task Force under the auspices of the Helsinki Commission (HELCOM). The Task Force has developed a work plan which provides for the development of the Joint Comprehensive Programme. This plan calls for preparation of a series of Pre-Feasibility Studies for Priority Areas. A Pre-Feasibility Study has been undertaken for the whole of the Oder/Odra River Basin.

The Oder/Odra River Basin study area included the entire drainage basin of the Oder/Odra River in the Czech Republic, Republic of Poland and the Federal Republic of Germany. The objective of the study is to prepare a priority action programme to pre-feasibility level to control and reduce the present pollution of the Baltic Sea from the Oder/Odra River Basin in line with the 1990 Baltic Sea Declaration. This includes a target objective of the adoption of measures by the countries in the region to reduce the 1987 emission levels by 50% by 1995.

The French consulting company BCEOM in co-operation with several local consulting firms in the region was contracted by the European Investment Bank (EIB) to undertake the pre-feasibility study. This study has identified several pollution "hot-spots" in the Ostrava region and proposed measures to reduce the emission levels from these. The priority action programme includes measures in the Ostrava region even though the discharges are located a long distance from the Baltic Sea.

The Baltic Sea study aims at reducing the pollution load to the Baltic Sea and not specifically to improve the local water quality situation. Measures that will reduce the input to the Baltic Sea will, however, also contribute to the improvement of local water quality in the area. Since the study focuses on the Baltic Sea the priority action plan emphasises measures with significant effects on the Baltic Sea and not local effects.

To improve the local water quality situation in the Ostrava region it is necessary to identify the sources to pollution which cause the most severe local impacts. These sources should be targeted for action when the objective is to improve the local water quality.

The pre-feasibility study for the Oder/Odra River Basin will serve as a basis for the proposed project "Environmental impact analysis of the Odra catchment area."

1.2 The Project "Silesia" - the Regional Environmental Programme In Northern Moravia

The project "Silesia" has been formed on the basis of the activities of the World Bank and represents an external aid to the protection of the environment in the Czech Republic. The project is executed by representatives of the CSFR, Poland, World Bank and US-EPA.

The objectives of the Czech-Polish project "Silesia" are to stop the process of environment deterioration in the model area; to reach a significant improvement of main ecological characteristics; and to create conditions for the realisation of the sustainable development strategy in the model area.

To reach these objectives an information, methodological and expert database will be formed and several sub-projects dealing with technological, economical and legal aspects will be integrated into a Master Plan for the region.

Currently Phase 1 of the project has been completed. Phase 1 involves gathering and assessment of available data, gathering of additional data and performing a comparative environmental risk screening analysis. Phase 2 will involve further data collection and monitoring, economic screening analysis and preparation of mitigation strategies for the improvement of the environment in the area.

Project "Silesia" has so far concentrated on air pollution problems. However, water pollution problems also have been dealt with. Project "Silesia" will provide useful data for this project, especially data on discharges. In a meeting with representatives of the "Silesia" project it was clarified that this study will be complementary to the "Silesia" project.

1.3 The Project "Silesia" - Screening analysis of surface water contamination

The screening analysis performed by the Industrial Economics Incorporated, USA, on behalf of the U.S. Environmental Protection Agency provides very rough approximations of the human health and ecological risks posed by surface water contamination. In particular, the human health individual risk estimates are subject to a wide variety of uncertainties and biases. In the analysis the surface water quality in the Odra, Ostravice, Olse, Opava and Moravice Rivers has been assessed by characterising current levels of risk to human health and aquatic life. In addition, the analysis has identified the major sources of surface water contamination. For certain pollutants not currently monitored the results are based on a rudimentary release estimation and dilution approach that likely overstates the level of risk (Industrial Economics 1992).

The risk to human health has been characterised in terms of the potential individual risk of cancer and non-cancer health effects associated with exposure to pollutants through recreational use of surface water. The ecological risk is characterised in terms of areal extent of pollutants stress, as measured by kilometres of river at risk of aquatic toxicity (to fish, invertebrates, and plants) and in terms of the severity of pollutant stress.

The main results of this analysis will be presented later in this report. It should be noted that this analysis is partly based on U.S. EPA water quality standards.

2. OBJECTIVES OF THE PROJECT

The main long term objectives of the project are:

- to develop planning tools for the elaboration of an optimal strategy for cost-effective water pollution abatement in the river Odra catchment area;
- to analyse the economic situation from the point of view of environmental impact assessment (EIA);
- to analyse the social situation from the point of view of EIA;
- to analyse the possibilities of the improvement of the water quality in the Odra River.

Short term objectives

- to organise the study team - including meetings, discussion, surveys in the Czech Republic and Norway;
- to assess already existing data concerning Environmental Impact Assessment;
- to analyse the ecological situation in the Odra River Basin;
- to specify parameters and data which are not available in the Czech Republic and establish monitoring programmes to collect needed data.

These objectives are comprehensive and require quite extensive analysis of the situation in the Odra River Basin. This report which covers the short term objectives will focus on assessing the available data and analysing the ecological situation in the Odra River Basin.

3. DESCRIPTION OF THE STUDY AREA

3.1 Geography

The Odra River Basin in the Czech Republic has a total area of 6,400 km^2, which constitutes 5.5% of the total catchment area of the Oder/Odra River. Oder/Odra River has a total length of 854 km and a catchment area of 118,900 km^2. In the Czech Republic the catchment area extends in the Northern Moravia region and a small part in the Bohemia region.

The length of Odra river in the Czech Republic is 120.1 km. The average yearly inflow to Poland from Odra River is 43.3 m^3/s, from Olse River 12.5 m^3/s and the minimum flow in Odra River is 6.2 m^3/s (Q_{355}) and in Olse River 1.63 m^3/s ((Q_{355})).

In the Czech part of the river basin the number of inhabitants is 1.4 million, which gives a population density of 224/km^2. Approximately 1 million inhabitants live in urban areas. The largest cities in the region are shown in table 1.

Figure 1 shows the study area.

Table 1. Overview of the largest cities in the Czech part of the Odra River Basin

City	Inhabitants
Ostrava	331,000
Frydek-Mistek	66,000
Opava	63,000
Havirov	92,000
Karvina	70,000
Krnov	26,000
Bruntal	19,000
Orlova	38,000
Jesenik	15,000
Cesky Tesin	29,000
Trinec	46,000
Novy Jicin	33,000
Koprivnice	24,000

The industrial development in the Odra River Basin has been based on the exploitation of coal mines both in Poland and in the Czech Republic, supporting the development of the power and metallurgy industry. Most of the coal mines are situated in the Ostrava and the Liberec areas. Over 80% of the bituminous coal extraction in the Czech Republic takes place in this area.

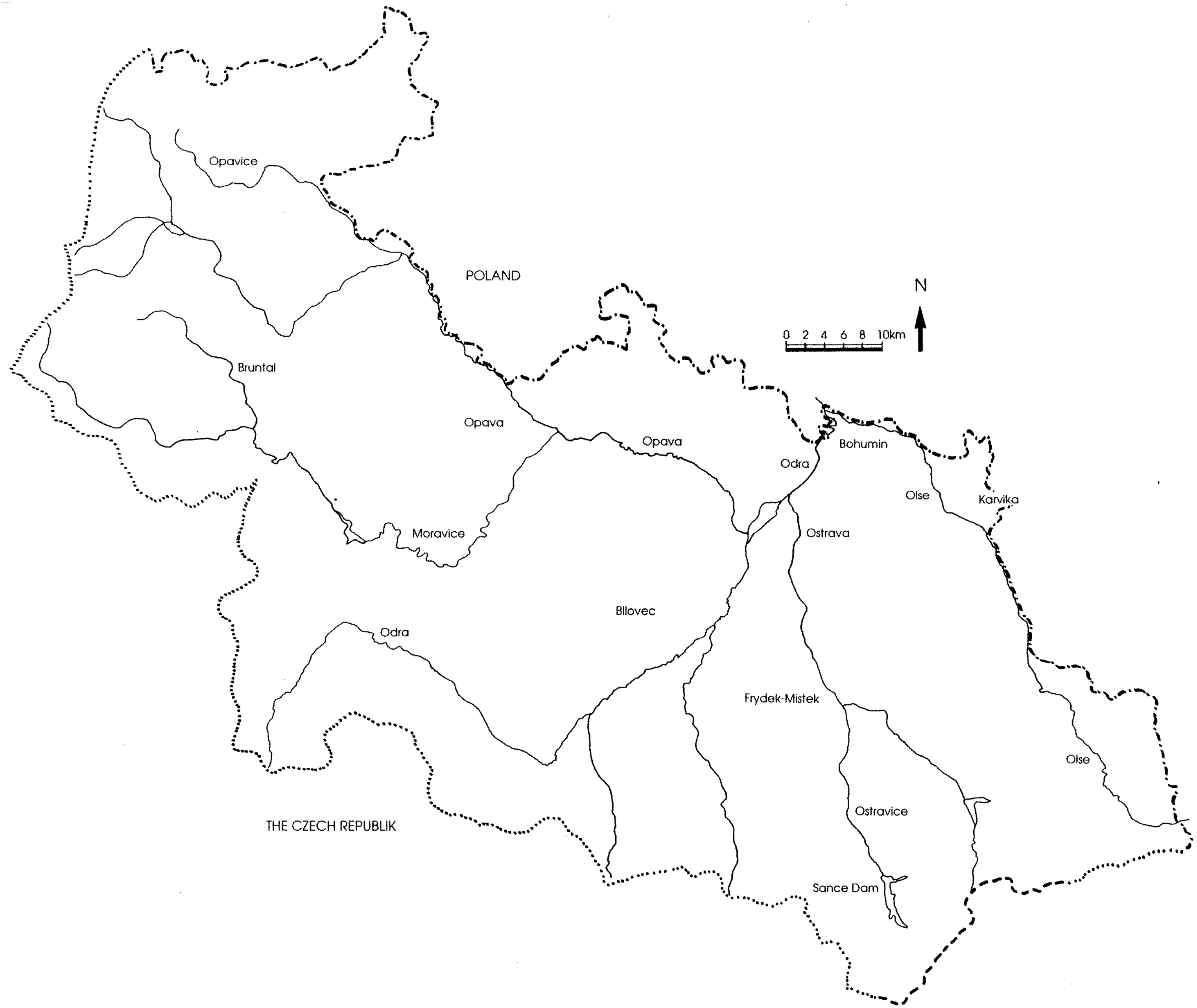

Figure 1. Map of the study area

In the Czech part of the Odra River Basin 3,270 km^2 is agricultural land, i.e. 52.2% of the total catchment area. Forests constitute 36% of the total area. The main crop is potato. There are many pig and cattle breeding farms.

The application of mineral fertilisers has increased with the subsequent drainage of land.

Large parts of the catchment area are covered by forest. Forestry is a major activity in the region and forms the basis of several industries.

Inland fisheries are taking place in all reservoirs and fish ponds, particularly confined to reservoirs (Kruzberk, Moravka and Sance dams). No extensive data on fish are available. However, due the considerable discharges of pollutants from industrial sources the fish is probably not safe for human consumption. Due to the pollution parts of the river systems are devoid of fish.

In the Odra River there is no regular navigable route. Plans exist, however, to construct a navigable fairway in the region.

3.2 Water use

Annually 370 million m^3 water is withdrawn from the river system (surface water). Industry is the most important water user, 60-65% of the total withdrawals. Water works withdraw 133 million m^3 water annually.

The water consumption shows a slight decline the last years. Further decline is expected.

Withdrawals of underground water amounted to 52 million m^3 per year during the last decades.

3.3 Environmental management system

The central authority of the state administration in the field of environmental protection of the Czech republic is the Czech Ministry of Environment situated in Prague, with nine territorial department offices; one of them is in Ostrava. The main areas of responsibility is management of water, air and soil pollution, water management, water supply, atmosphere protection, waste management, construction/building regulations, territorial planning, geology, forestry, agriculture, and nature protection.

The Ministry of Environment administers the Czech Environmental Inspectorate. Other authorities of the state administration are the district authorities and municipalities that are responsible for environmental protection.

<u>Czech Environmental Inspectorate</u>

The inspectorate is divided in five departments:

- forest protection

- atmosphere protection
- waste management
- water protection
- nature protection

The inspectorate is supported from the state budget and its main activities are:
- undertaking inspections
- imposing penalties for infringement of laws and regulations
- closing of operation of enterprises
- charging institutions with responsibilities of implementing measures.

Further there are organisations responsible for water management, water supply, wastewater treatment, maintenance of watercourses and reservoirs.

North Moravia Water Main and Sewerage

This institution is responsible for drinking water supply, operation of sewerage systems, treatment of municipal wastewater in the districts of Novy Jicin, Frydek-Mistek, Karvina and Opava. In district Ostrava these activities are taken care of by Ostrava Water Main and Sewerage and Regional Water Supply Main Ostrava.

Odra River Basin Enterprise (Povodi Odry)

This organisation is responsible for the management, operation and maintenance of rivers, water supply reservoirs, flood protection, and care of surface water quality. Further activity is preparation of state water plans, preparation and realisation of water works construction and other project activities.

Povodi Odry is the key organisation responsible for monitoring of water quality in rivers and reservoirs and monitoring of discharges.

4. ENVIRONMENTAL STATUS AND TRENDS

4.1 Monitoring

A comprehensive water quality monitoring programme is executed in the Czech part of the Odra River Basin. Povodi Odry and WRI-O sample 80 control points once or twice every month. Normally 30 water quality parameters are analysed. In addition there are 7 automatic monitoring stations. One of these is located on the Polish Border.

Data from the monitoring programme have been made available by Povodi Odry.

The water quality is classified according to the CSN 72 7221 - Classification of surface water. This classification system was enacted in 1990. The water quality is classified according to five classes;

Class I	Very clear water, usually suitable for all applications
Class II	Clear water, suitable for the majority of applications
Class III	Polluted water, suitable for supply of industry only
Class IV	Very polluted water, suitable only for limited applications
Class V	Extremely polluted water, unsuitable for any application

Upper limits are given for 41 parameters for each class (radioactivity indicators is not included). The water is classified in a specific class if the probability of exceedance of one parameter is below 10%.

Compared to Norwegian Water Quality Criteria the Czech standards are high. The difference in natural water quality is considerable so the standards are not comparable. However, for several of the parameters the level of concentration is set rather high. The results of the monitoring programme should be related to the standards.

As part of the this joint programme a separate study is initiated to classify the water quality in the Odra River according to international criteria for classification of water quality (project 3.3). Results from this programme should be seen in conjunction with this project.

The environmental state of the rivers in the region is described further in section 4.3 of this report.

The upper part of the Odra River, Ostravice and Olse, is characterised by reasonably good water quality, class I to II. The oxygen concentration is normal. The water is, however, influenced by discharges of bacteria and suspended solids mainly from agriculture. The water quality deteriorates considerably in the Ostrava city region. Before the city the water quality is classified in class III - suitable for industrial use. Downstream of the Ostrava city the river is classified in class III for BOD, class IV for chemical parameters (ammonia) and class V for bacterial pollution (E.coli).

4.2 Pollution loading

The pollution load from the rivers Opava and Ostravice entering the Odra River in 1990 is shown in table 2.

Table 2. Pollution load from the rivers Opava, Ostravice and Olse to the River Odra in 1990. Selected parameters.

Parameter	Opava tonnes/yr	Ostravice tonnes/yr	Olse tonnes/yr	Total tonnes/yr
BOD_5	1151	1702	2000	4853
COD-Mn	1529	5920	3357	10806
NH_4	443	703	947	2093
NO_3	1127	1021	788	2936
NO_2	21	44	90	155
PO_4	142	66	162	370
Total Fe	141	246	-	>387
Zn		35.3	16.97	>151
Cu		2.09	3.49	>5.58
Ni		5.69	12.56	>18.25
Cr		3.90	2.99	>6.89
Cd		0.92	2.38	>3.3
Pb		4.76	7.59	>12.35
Hg		0.14	0.11	>0.25

Currently results of all parameters are not available for each monitoring profile. For comparison and to determine the total loading to the Odra River comparable data are needed.

Table 3 shows the total load from the Czech part of the Odra River to Poland. The figures are based on the reported monitoring programme. Several parameters are lacking in table 3.

The monitoring programme is aimed at determining the load of organic material primarily. Few data can be used to determine the load of nutrients, total nitrogen and total phosphorus. The load of heavy metals is uncertain. So far no analysis has been made to determine the load of micro pollutants. Povodi Odry and WRI-O have started with analysis of micro pollutants in approximately 10 main profiles (6 samples in 1992).

When more detailed data become available the total pollution load to the Odra River will be calculated. This will form the basis for an assessment of the water quality situation in the river.

Table 3. Pollution load entering Poland from the Odra River Basin in 1990.

Parameter	Odra-Bohumin tonnes/yr
BOD_5	7789
COD-Mn	11984
NH_4	3411
NO_3	4286
NO_2	-
PO_4	-
Total Fe	1892
Zn	634
Cu	12.5
Ni	22.1
Cr	38.8
Cd	
Pb	
Hg	0.32

4.3 State of the rivers

In the following paragraphs a brief overview of the water quality situation in the largest watercourses is given. In addition the largest sources to pollution are identified.

The water quality in streams in the Czech part of the Odra catchment area is regularly observed in 45 main stationary profiles. Povodi Odry makes analysis of physical, chemical, bacteriological and biological parameters in all of these profiles 12 times a year. WRI T.G.M. makes the same analysis 24 times a year in approximately 10 profiles which are selected every year according to the needs of its research programmes.

The upper parts of main tributaries of the Odra (the rivers Opava, Ostravice and Olse) incl. the Odra itself have good oxygen concentrations, water there is characterised as very clean or clear (classification according to Czech norm). The pollution of undissolved substances and bacteria influenced by erosions and recreation is a negative factor, but the water quality of the streams are considered reasonably good.

The middle parts of the main tributaries of the Odra, including the Odra itself, have considerably worse water quality mainly due to the influence of greater industrial and urban centres (mainly organic and bacterial pollution), that is caused largely by the insufficient capacity of wastewater treatment plants. The pollution caused by agriculture is also dominant.

Before the confluence of the Odra and its main tributaries into the Ostrava industrial conurbation (that has major influence in the pollution of water) is the river water quality characterised as polluted water (according to Czech norm) suitable only for supply of industry.

After the confluence of the Odra into Ostrava industrial conurbation, the quality of its water is considerably worsen, because there is a dense concentration of industry and build-up area there. The Odra river also takes in its main tributaries there. It is the Opava river from left (river km 17,5) which is characterised in the mouth according to oxygen parameters like polluted water (BOD 5), according to chemical parameters like very polluted water (ammonia ions) and according to bacterial pollution (coli) like extremely polluted water.

From right Odra takes in Ostravice river (river km 10,9) which is characterised in the mouth according to oxygen, chemical and bacteriological parameters like extremely polluted water.

Further considerable tributary from right is Olse river, which is also extremely polluted, but it does not influence the quality of water in the Odra in the territory of the Czech Republic (confluence Odra-Olse is on the Czech Republic Poland border).

Main rivers in the Odra catchment area:

Odra river

The Odra rises on the territory of the Czech Republic and its length is approximately 130 km. The river makes the border with Poland from kilometre 4.1 (Chalupki the railway bridge) to kilometre 0.0 (confluence with Olse river).

The first part of Odra river where the water quality is affected is after confluence with Jicinka, caused by influence of Novy Jicin treatment plant. Considerable water quality deterioration is in the Odra downstream Opava profile caused by influence of the sewage from sewers draining Zabreh and Svinov and treatment plants Zabreh and Seliko Svinov - North Moravian Distilleries and Canneries.

The second critical part is affluent under Ostrava with great pollution loading from Ostravice river and city sewage treatment plant Ostrava including bypass of this treatment plant. A new treatment plant is under construction (planned completion in 1995).

Tributaries

Jicinka river

Water quality is affected by waste water of North Moravian Dairy Plants Kunin and Novy Jicin treatment plant.

Husi potok

Waste water from Masospol - Big pig farm Brezova is discharged there.

Bilovka

This is the most polluted tributary in the Odra river basin. Un-treated sewage water from Bilovec town, insufficiently treated waste water from State agriculture farm - Big pig farm Bravantice and Velke Albrechtice and waste water from Massag Bilovec are discharged there.

Porubka

Extremely polluted tributary by sewage water from Ostrava-Svinov and industrial waste water from Seliko Svinov.

Bohuminska struzka

Very polluted tributary by wastewater from Freezing store Bohumin, Bochemie - chemical plant Bohumin, Iron and Wire Works Bohumin and sewage water from Bohumin town.

Ostravice river

The Ostravice rises in the massif of Moravian - Silesia Beskydy and its length is approximately 62 km. The upper third of the river flows trough reservoir Sance which is used for drinking water supply.

In the part downstream of the city Frydek the river becomes very polluted by discharges from (overloaded) wastewater treatment plant Frydek (at present under reconstruction; planned completion in 1994) and Sheet Mills Frydek-Mistek. The part from river km 8,6 to the mouth is mainly influenced by waste water from Biocel Paskov pulp mill. In the part from Ostravice upon Lucina to Ostravice - Muglinov the concentration of BOD_5, dissolved substances, sulphates and chlorides grows. There is also influence by salinity mine waters.

Tributary

Lucina river

Water quality of the Lucina river in the mouth is evaluated as very polluted water caused mainly by discharges from treatment plant Havirov (at present under reconstruction; planned completed in 1994).

Opava river

Opava is the longest river in the Odra catchment area and its length is approximately 131 km. The river makes the border between Krnov and Opava with length 21.5 km. The first part where the water quality is affected (BOD_5) is under Krnov, considerable pollution is in the profile Opava river downstream of Opava. The greatest polluter on the upper part is the treatment plant Krnov and treatment plant Opava with insufficient treatment efficiency.

Concentration of BOD_5 in the lower part of the tributary is partly decreased caused by self purification.

Olse river

The Olse river rises on the territory of Poland and enters into the territory of The Czech Republic in locality Bukovec (river km 73) Its length in the Czech territory is approximately 87 km. From river km 24.6 the river makes the state border with Poland.

The water quality is affected downstream of Trinec by ammonia ions and phenols. This is mainly caused by influence of wastewater treatment plant Trinec (at present under reconstruction; planned completion in 1994). Ammonia-phenol wastewater from Trinec Iron and Steel Works is treated there. The concentration of BOD_5 increases in profile Olse below Cesky Tesin. Olse is extremely polluted in profile Olse-Vernovice by dissolved substances and chlorides. Their source is pollution from Poland as well as from the Czech Republic.

It will be necessary to evaluate import of Poland pollution - Tributaries Sotkuvka, Bobrovka, Puncovka.

Sediments

So far few sediment samples have been taken in the region. Due to lack of analytical capability and experience with sediment sampling there is a need to initiate a limited sediment sampling programme. WRI-O is planning to start a sediment sampling programme in 1993. In addition the Mining University has experience in this field. Analysis of sediments reveal the pollution history of the region and is useful to describe the problem with heavy metals and micro pollutants.

4.4 Results of the sampling programme

During its mission to the Ostrava region in September 1992 NIVA took water quality samples in Olse, Ostravice, Opava, Odra and Bilovka Rivers. The profiles sampled are shown below, table 4.

The samples were analysed by NIVA, Povodi Odry, and WRI-Ostrava. The following parameters were analysed; pH, conductivity, turbidity, tot-P, PO_4, tot-N, NO_3, NH_4, Fe, Mn, Cu, Zn, Cd, Cr, Ni, and Pb. The results are presented in tables 5 and 6.

Table 4. Profiles sampled in the Ostrava Region in September 1992.

Profile No.	River	Location
1	Odra River	Bohumin
3	Odra River	Petrkovice
6	Odra River	Polanka
14	Bilovka	Below Sezina
19	Olse River	Vernovice
24	Olse River	Ropice
31	Ostravice River	Muglinov
33	Ostravice River	Vratimov
37	Ostravice River	Below Sance Dam
50	Opava River	Estuary

Table 5. Results of NIVA's sampling programme in September 1992. Nutrients.

Location	Cond	Turb NTU	Tot-N µg/l	NO_3 µg/l	NH_4 µg/l	TOT-P µg/l	PO_4 µg/l
37 Sance Dam	11.8	0.86	1480	1470	9	3	<1
31 Ostravice	143	8.2	6000	3720	1640	726	496
33 Ostravice	41.4	5.1	3610	2640	446	347	313
1 Odra	130	23.0	9050	3390	4030	660	506
3 Odra	56.7	6.1	9950	4290	2960	996	884
6 Odra	59.3	20.0	5010	3120	600	428	321
19 Olse	725	6.5	9650	3690	4510	954	836
24 Olse	60.7	5.6	13800	1830	11200	746	624
14 Bilovka	63.5	4.8	13750	506	11200	2920	2830
50 Opava	41.5	6.0	4120	2490	344	638	578

Table 6. Results of NIVA's sampling programme in September 1992. Metals.

Location	Fe mg/l	Mn µg/l	Cu µg/l	Zn µg/l	Cd µg/l	Cr µg/l	Ni µg/l	Pb µg/l
37 Sance Dam	0.083	0.06	1.6	<0.01	<0.01	<0.10	1.3	<0.5
31 Ostravice	1.17	0.27	4.6	0.14	0.14	0.30	6.9	3.2
33 Ostravice	0.38	0.07	2.8	0.02	0.02	<0.10	2.7	1.9
1 Odra	1.59	0.33	4.0	0.81	0.81	0.47	4.9	3.1
3 Odra	0.84	0.26	5.7	0.04	0.04	<0.10	7.0	2.2
6 Odra	1.50	0.34	2.2	0.01	0.01	<0.10	2.7	0.9
19 Olse	0.64	0.32	2.5	0.03	0.03	0.43	3.6	1.5
24 Olse	0.49	0.13	4.9	0.25	0.25	0.16	3.3	6.1
14 Bilovka	0.58	0.37	70	0.10	0.10	<0.10	77.3	0.8
50 Opava	0.71	0.15	2.1	0.05	0.05	<0.10	3.5	1.0

The analysis show high concentrations of nutrients in all the sampled profiles, except below Sance Dam which is almost unaffected. Based on the analysis it can be concluded that discharges of nutrients and organic matter seem to be the most important water quality problem in the region. The concentrations of heavy metals are lower than the industrial activity should indicate.

In Appendix 2 the results of the analysis performed by the Water Research Institute - Ostrava Branch are enclosed.

4.5 Risks to human health

The recreational risks to human health have been determined for swimming. As part of the analysis five official recreational swimming sites have been identified in the region. Measured concentrations on total coliform indicate the potential for exceedences of U.S. EPA recreational water quality guidelines by a factor of between 1.06 and 63. This finding suggests that swimmers at these sites may be at risk of contracting the gastrointestinal illnesses associated with bacteria. Other recreational risks to human health are probably low.

The potential average lifetime cancer risks at two recreational swimming sites based on estimated concentrations of 12 carcinogens, are $2x10^{-6}$ and $7x10^{-6}$. The risk is mainly attributable to high estimated arsenic concentrations. Cancer risks from ingestion of recreationally caught fish are potentially higher. Olse River angler data indicate that average lifetime cancer risks could be as high as $3x10^{-4}$. Annual cancer cases associated with eating these fish are probably less than 1 per year.

4.6 Ecological risks

The areal extent and severity of surface water contamination for each of the five major rivers in the study area has been determined by using monitored concentrations of dissolved oxygen, ammonia and iron at 70 sites, eight metals at nine sites, and five organics at six sites. The number of pollutants exceeding criteria and the severity of exceedences is calculated for all pollutants.

The results show that chronic ecological surface water criteria could be exceeded in between 26 and 82 percent of the individual rivers examined, or approximately 57 percent of all river kilometres examined, see table 7. These exceedences are caused by several pollutants; in each river, concentrations of between 1 and 9 pollutants are higher than their criteria. For the entire river system, 11 of the 19 monitored pollutants register exceedences. The analysis shows that one pollutant monitored at three of the 70 stations, mercury (Hg), may exceed its criteria by greater than 10 times (83 times at the maximum).

Table 7. Summary of areal extent and severity of surface water contamination in the study area. The analysis is based on monitored concentrations and U.S. EPA aquatic toxicity criteria (Industrial Economics 1992)

River	Total river kms examined	River kms with exceedences	Number of pollutants exceeding criteria	Number of pollutants exceeding 10 times criteria
Ostravice	54.0	16.5 (31%)	8	1
Olse	50.6	39.9 (79%)	7	1
Moravice	82.4	21.6 (26%)	1	0
Opava	74.8	61.2 (82%)	6	0
Odra	86.1	59.8 (69%)	9	1
Total	347.9	199.0 (%/%)	11	1

Measured concentrations of ammonia and iron exceed their criteria throughout the study area for a total of 155.7 and 184.7 kilometres. Levels of dissolved oxygen are below the standard in 10.2 kilometres. The most severe measured exceedences are for mercury (Hg), copper (Cu) and PCBs.

The analysis suggests current levels of surface water contamination present significant risks to aquatic life. Data on conventional pollutants, based on ambient and effluent monitoring data, strongly suggest than an immediate focus on sewage treatment plants (COVs in Czech) could reduce ecological risk from conventional pollutants. Even though monitoring data on sources of metals/inorganics and organics contamination are scarce the findings indicate a very strong potential for high levels of metals contamination throughout the river system, and suggest additional monitoring of these pollutants, particularly mercury, copper, lead, chromium, and PCBs.

4.7 Intercalibation of laboratories

As part of the co-operative programme in 1992 NIVA prepared inter-calibration samples for analysis. The samples were analysed at WRI-O and Povodi Odry. The objective of the inter-calibration programme was to check the performance of each laboratory and to evaluate the validity of the reported data.

The inter-calibration programme shows clearly that the reported results are good enough to be used in the assessment of the environmental situation. A more comprehensive assessment of the inter-calibration results will be performed at a later stage in the project.

Table 8. Results of the inter-calibration programme.

Parameter		NIVA "True" value Sample/Result		WRI-Ostrava Sample/Result		Povody Odri Sample/Result	
		G	H	G	H	G	H
Tot-P	mg P/l	0,63	0,54	0,66	0,58	0,82	0,61
Tot -N	mg N/l	5,04	4,32	9,7	8,3	4,5	-
		K	L	K	L	K	L
Pb	mg Pb/l	0,32	0,28	0,4	0,4	0,33	0,28
Fe	mg Fe/l	0,32	0,4	0,28	0,35	0,31	0,4
Cd	mg Cd/l	0,053	0,047	0,038	0,036	0,057	0,045
Cu	mg Cu/l	0,16	0,14	0,16	0,16	0,17	0,15
Cr	mg Cr/l	0,32	0,257	0,3	0,26	0,3	0,24
Mn	mg Mn/l	0,48	0,3	0,44	0,4	0,5	0,41
Ni	mg Ni/l	0,228	0,36	0,24	0,28	0,29	0,36
Zn	mg Zn/l	0,192	0,24	0,16	0,19	0,18	0,23
		C	D	C	D	C	D
Ca	mg Ca/l	3	3,5	4	4	2,9	3,5
Mg	mg Mg/l	0,84	0,7	0,61	0,85	0,82	0,68
Na	mg Na/l	2,4	2	2,3	1,9	2,5	2,3
K	mg K/l	0,6	0,5	0,5	0,4	0,57	0,46
Cl	mg Cl/l	5,31	6,19	7,4	7,8	5,6	6,3
SO4	mg SO4/l	9,07	7,56	7,6	-	12,6	11,3
		A	B	A	B	A	B
pH		7,4	7,16	7,4	7,2	7,5	7,2
Conductivity	mS/m	299	282	261,6	247,2	305	278
Tot. diss. sol.	mg/l			2635	2665		

5. OVERVIEW OF THE MOST IMPORTANT POLLUTION SOURCES

5.1 Industrial sources

The Ostrava Region is a heavily industrialised area. Several highly polluting industries are located in the region. Based on the submitted information to the Baltic Sea Environmental Programme's study team there are 47 major polluting enterprises in the Odra River Basin, 13 in the Luzicka Nisa River Basin and 4 in the Smeda River Basin. The dominating branches of industry are chemical plants, pulp and paper mills and metallic industry.

Annex I contains a list of the most important industrial sources in the region. This list has been prepared on the basis of material prepared by WRI-O. In relation to this list it is necessary to clarify some important aspects. These are:

1. Due to lack of discharge data the pollution loading from the major enterprises in the region has to be calculated theoretically. Production figures are necessary to calculate the pollution load from each enterprise. To determine the need for pollution abatement we need information on specific discharges per tonnes produced. In addition information on the actual production process, level of internal treatment and production is needed.

   The U.S. EPA screening analysis has estimated the pollution loading by using U.S. average discharges and U.S. standards. There is a need to revise and update these estimations. However, results from the Silesia screening analysis will serve as a useful background for the analysis, especially regarding micro pollutants.

2. The reported discharge values are not sufficient to prepare a pollution budget for the region. Due to lack of measurements several important pollution parameters are not reported for several industrial sources.

   The overview of discharges should be updated. However, most likely data are lacking. Based on production figures and processes it is possible to calculate the expected pollution load from each major enterprise.

   It will be necessary to set a minimum dishcarge limit for the sources to be included in the pollution budget. However, this limit should be flexible to allow for inclusion of specific activities which discharge micro pollutants.

3. The high industrial activity in the region indicates that the most severe pollution problems might be connected with discharges of heavy metals and micro pollutants. Due to lack of analytical methods and equipment analysis of micro pollutants has not been undertaken. Preliminary analysis suggest that discharges of nutrients and organic matter are of particular concern

To rank the industrial sources according to their relative importance as pollution hot-spots more information on discharges is needed. If such data are not available we have to base the ranking of the most important pollution hot-spots on experience from similar areas and enterprises.

4. For each enterprise information on the level of treatment should be given (type of treatment plant, capacity and treatment efficiency).

5. Most enterprises discharge the effluent water directly into the river system. However, some enterprises probably discharge effluent water in the municipal sewer system. For each enterprise the discharge system should be clarified.

Povodi Odry monitors the largest sources to water pollution in the region. However, only a limited number of enterprises is monitored.

5.2 Municipal sources

The sewerage systems in the Ostrava Region is the responsibility of the North Moravian Water Mains and Sewerage Ostrava. Currently approximately 73% of the inhabitants are connected to municipal sewerage systems.

Several sewage treatment plants have been constructed in the region. Available information indicates that there are 17 sewage treatment plants. Most of the plants are mechanical-biological (activated sludge). The reported treatment efficiency for most plants for BOD5 is 80-95% which indicate that the treatment plants are operated fairly well. However, the reported treatment efficiency has been questioned. Most plants are biological plants and as such the removal of nutrients, N and P, is small. Most plants are overloaded and the resulting discharge of pollutants is considerable. Below is shown some data for the central sewage treatment plant for Ostrava.

	Average value BOD5	Average value TSS	Volume 10^3 m^3/yr	BOD5 t/yr	TSS t7yr
Sewage	16	33	32 135	514.2	1 060
Bypass	217	136	2 250	488.3	306

Table 9 shows the sewage treatment plants in the region, the volume of waste water treated, population equivalents connected to the plant and treatment efficiency.

As seen from table 9 the daily water consumption varies considerably. For several of the treatment plants the reported water volume or the connected population equivalents seem too low or too high. Values around 200 - 300 l/PE day seem normal.

Table 9. Municipal sewage treatment plants in the Ostrava region. Source: WRI-O, 1991.

City	Type	Volume m^3/day	Population equivalent	l/PE day	Efficiency BOD_5 in %
Ostrava-Privoz	A	60189	334170	180	90.0*
Ostrava-Trebovice	A	45934	243730	188	91.0
Frydek-Mistek	C	24465	174250	140	91.0*
Opava	A	20300	154630	131	84.0*
Havirov	B	31500	100990	312	80.0
Karvina	B	22500	89900	250	80.5
Krnov	A	14027	79425	177	92.0
Bruntal	A	11232	37500	299	89.1
Orlova	A	16522	36530	452	90.0
Jesenik	A	19000	32900	577	93.0
Cesky Tesin	A	9245	31570	292	90.5
Trinec	A	8550	28534	299	90.7
Novy Jicin	A	8696	27730	313	98.1
Ostrava-Zabreh	B	1951	23960	81	84.0
Koprivnice	B	5970	20340	294	85.0

Note: A: mechanical-biological (activated sludge)
B: mechanical-biological (biofiltration)
C: mechanical-biological without primary sedimentation
*: Efficiency is calculated without by-pass.

Table 10 shows the reported discharges from each sewage treatment plant.

Table 10. Reported discharges from the main sewage treatment plants in the Odra River Basin. Source: WRI-O, 1991

City Treatment plant	Volume $m^3\ 10^3/yr$	BOD_5 t/yr	COD t/yr	Tot-P t/yr
Ostrava-Privoz	32129	578	3695	67.5
Ostrava-Trebovice	14869	387	1398	35.4
Frydek-Mistek	17207	1347	3063	37.6
Opava	9042	722	1186	19.8
Havirov	9758	268	907	25.4
Karvina	9647	254	1061	22.0
Krnov	5798	251	676	15.1
Bruntal	4927	277	464	11.3
Orlova	3104	158	590	8.3
Jesenik	4517	122	514	7.2
Cesky Tesin	3273	61	278	7.5
Trinec	4180	112	514	7.2
Novy Jicin	5465	144	661	12.5
Ostrava-Zabreh	1781	57	210	6.5
Koprivnice	3200	45	214	7.3
TOTAL		4838	15431	>290.6

It should be noted that there are discrepancies regarding the volume of waste water in the two tables above. The tables indicate that a considerable amount of waste water is discharged without any treatment, i.e. the treatment capacity is too low. In some cases the dishcarge of treated waste water is approximately one-third of the total waste water volume.

The total produced load of nutrients from municipal sources to watercourses in the region is in the order of 1300 tonnes tot-P(2.5 g tot-P/person day). Since 73% of the inhabitants are connected to municipal sewerage systems the total theoretical load is approximately 1000 tonnes. Based on the received information approximately 1.3 million inhabitants are connected to municipal sewage treatment plants. This value seems too high. If the figures are correct the overall treatment efficiency for tot-P is 70% which seems too high since all treatment plants are biological. The load of phosphorus from municipal sources seems underestimated.

The corresponding load of nitrogen from municipal sources is in the order of 6100 tonnes per year (12 g tot-N/person day). Since 73% of the inhabitants are connected to sewerage systems the load will be approximately 4000 tonnes per year (estimated 10% treatment efficiency for nitrogen).

5.3 Agricultural sources

Agriculture constitutes approximately 50% of the total area of the region. The total fertilisation intensity (mineral and manure) is estimated to 110 kg N/ha and 27 kg P/ha. The nutrient runoff from agricultural fields is estimated to 23 kg N/ha year and 0.22 kg P/ ha year. This gives a total load of 9000 tonnes of N and 72 tonnes of P.

In addition to runoff from fields point sources have to be included. Based on NIVAs topical area study for agricultural runoff (Baltic Sea Environmental Programme), the total load of pollutants from agriculture to watercourses in the Ostrava region is in the order of 10,800 tonnes of nitrogen and 250 tonnes of phosphorus (calculated from the figures proposed for the Odra River catchment in Poland). The most important sources to inputs of phosphorus is leakages from manure storages. Possibly these values are overestimated since the calculation is based on the average conditions in the whole Odra River Basin.

The load of nutrients from agricultural sources should be calculated more in detail. However, more data are needed. The calculation has to be based on total number of animal units, use of mineral fertilisers, total area, and so forth.

Most of the pollution load from agricultural is being discharged to smaller rivers and creeks. Retention and denitrification will reduce the actual load considerably. Using 40% retention of P in primary receiving waters the total agricultural load will be approximately 150 tonnes. The loss of nitrogen is estimated to be 60% in the primary receiving waters, giving a total load of 4,500 tonnes of nitrogen.

5.4 Pollution load from the region

Table 11 shows the reported pollution load the Prefeasibility Study for Odra/Oder River Basin reported from the Czech Republic and the Czech Republic's national plan. The national plan only includes discharges from industries and municipalities.

Table 11. Annual pollution load from the Czech Republic to the Odra/Oder River Basin. Source BCEOM, 1992 and National Plan

Parameter	Load BCEOM t/y	Load National Plan t/y
BOD	6200	15,600
Tot-N		6445
Tot-P		283
Zn	460	788
Pb	16	6
Cu	5	21
Ni		36
Cr		26

A more detailed pollution budget will be prepared at a later stage in the analysis. Due to the amount of data needed to perform an detailed assessment of all pollution sources, the budget will be uncertain.

5.5 Preliminary evaluation of the most important sources

Numerous sources contribute to the pollution of the water courses in the Ostrava region. The effects on ecology and human health are significant.

The U.S EPA study has identified sewage treatment plants and sewerage systems as one of the major sources to discharges of organic matter (BOD), metals and inorganics. Other potentially major sources of loadings in each major river are listed below (Industrial Economics 1992):

Ostravice	Iron and steel, pulp and paper.
Olse	Iron and steel, steam electric, coal mining.
Moravice	Non-ferrous metals.
Opava	Moravice River sources, steam electric.
Odra	Opava River sources, Ostravice River sources, inorganic chemicals, iron and steel.

WRI-Ostrava has evaluated the most important sources to water pollution in the region and has given priority to the most important sources. The prioritization of pollution sources is not based on a well-defined set of criteria. However, available information on loadings, existing investment plans and the sources' relative contribution to the improvement of the water quality in the streams have been used. Based on these criteria the following sources are considered most important (WRI-Ostrava 1991):

Opava river basin

Inhabitants:
1. Waste water Treatment Plant Bruntal (at present under reconstruction, planned completion in 1993
2. Waste water Treatment Plant Rymarov

Industry:
1. Non-Ferrous Metal Works Bridlicna
2. Ostrava-Karvina, Power Stations - Power Station Trebovice

Odra river basin

Inhabitants:
1. City Sewage Treatment Plant Ostrava - II and III constructions
2. Sewer "D" Ostrava
3. Waste Water Treatment Plant Bohumin
4. Sewerage system Bilovec and waste water treatment plant Bilovec

Industry:
1. Iron and wire works Bohumin - construction of CANDOR pickling plant
2. State farm Bilovec - reconstruction of waste water treatment plant Bravantice and Brezova
3. North Moravian chemical plants - dephenolization of waste water
4. Ostramo Ostrava - oiled water treatment plant.

Ostravice river basin

Inhabitants:
1. Waste Water Treatment Plant Frydek - Mistek
2. Waste Water Treatment Plant Havirov

Industry:
1. Biocel Paskov - cellulose bleaching
2. New Metallurgical Works Ostrava - biological waste phenol-ammonia waters treatment plant

Olse river basin

Inhabitants:
1. Waste Water Treatment Plant Trinec II. construction
2. Waste Water Treatment Plant Karvina

Industry:
1. Trinec Metallurgical Works - reconstruction of water supplies management
2. Ostrava-Karvina Power Stations - power station. Detmarovice - construction of waste water treatment plant.

This determination of priorities for financial investments is based on pre-selected or given criteria. However, there is a need to develop a more stringent set of criteria to give priority to the most important sources to water pollution. WRI-Ostrava has proposed that determination of priorities should take account of:

a) amount of discharged polluted materials (or produced pollutants)
b) weighting of particular types of pollutants; how to give priority so sources which discharge nutrients, organic matter or heavy metals
c) location of the source of pollution
d) financial investments and operation and maintenance costs.

These criteria will form the basis of determination of a method for prioritization of the need for water pollution abatement of different sources to pollution.

6. PROPOSED WORK PROGRAMME

6.1 Introduction

The work programme has been prepared in detail in co-operation with WRI-O and IILE. The programme is based on the information presented in this report. Since several other studies are being executed in the region, the programme has been harmonised with these to avoid major overlaps. However, a certain degree of overlap is unavoidable. Elements of the work programme sufficiently covered in other studies are included in this work programme, however, the results from the other studies will be used to the extent possible.

6.2 Objective

The objective of the study is to develop planning tools for the elaboration of an optimal strategy for cost-effective water pollution abatement in the Odra River catchment area. The strategy will be based on a ranking of the most important sources to water pollution, i.e. pollution hot-spots in the region. The objective is further to develop a strategy that will solve the most important local water pollution problem. As such the ranking of hot-spots will be based on an evaluation of each source relative contribution to the local pollution problems.

The strategy will form the basis for the development of a priority water pollution action programme for the Ostrava region. The action programme will focus on solving the most important local water pollution problems. Environmental impact and risk assessment methods will be used to prioritise the most important sources to water pollution.

The objective is further to determine the total costs for the action programme. The cost estimates will be based on crude calculations of investment and O&M costs.

Another important aspect of the proposed study is the transfer of knowledge and methods between Czech and Norwegian scientists.

The long-term objective of the study is to prepare an environmental action programme for the region which can contribute to decisive reduction of emissions in order to restore the water courses to a sound ecological balance.

6.3 Scope of work

The study will address water quality problems in the Ostrava region in the Czech Republic. Main emphasis will be put on the major water courses in the region; Olse, Ostravice, Opava and Odra.

The study will involve the following tasks:

Task 1: Environmental status and trends in the study area

Sub-task 1.1 Review of existing monitoring data.

The monitoring data will be reviewed to assess the water quality situation in the major watercourses in the river basin. This review will be based on water quality data submitted by Povodi Odry.

Sub-task 1.2 Selected water quality sampling.

Selected sites were sampled by NIVA, WRI-O and Povodi Odry during a field visit to the region. Parallel sampling was undertaken to assess the quality of the local data. The sampling programme will focus on nutrients, heavy metals and some micro-pollutants. Due to financial resources only selected parameters will be analysed. There is a need to include selected sampling of micro-pollutants in the water courses (PCB, PAH and mercury (Hg) and other heavy metals). NIVA has extensive experience in such analysis while WRI-O and Povodi Odry have just started analysing these parameters. There is a need to discuss and compare methods.

In addition sediment sampling is proposed. Such sampling has not been undertaken in the region. Sediments reveal the pollution history of the region. This part of the work programme will concentrate on the transfer of methods to enable local institutions to execute needed studies in the future.

Sub-task 1.3 Inter-calibration of laboratories and analytical methods

As part of the project and the other proposed projects a limited inter-calibration programme of participating laboratories should be undertaken. WRI-Prague is already running an inter-calibration programme. This limited programme should be harmonized with the on-going programme of WRI.

There is a need to transfer and compare analytical and sampling methods. This will be an integral part of the proposed work programme. However, due to budget constraints this acitivity will be limited.

Sub-task 1.4 Assessment of effects on ecology and human health.

The effects of the present water quality on the ecology and the human health will be assessed. This will partly be based on U.S. EPA's risk screening analysis.

The assessment will be based on Czech and international water quality criteria. Results from project 3.3 Classification of water quality will be used in this phase. Most of the work will be done under project 3.3.

Task 2: **Environmental administration and policy measures**

Sub-task 2.1 Local and regional environmental administration

The existing environmental administration system will be assessed. The assessment will focus on regional and local administration.

Sub-task 2.2 Legal, economic and planning instrument

The legal basis for environmental protection will be assessed as well as the economic instruments used. In addition the system for water resources planning will be studied.

Task 3: **Sources to water pollution**

Sub-task 3.1 Inventory of sources to water pollution

The key point and non-point sources to water pollution in the region will be identified. For each source the annual loading will be determined. Where monitoring data are available such data will be used to assess the loading. If data are not available, the loading will estimated by using production figures and rudimentary release estimation and dilution approach.

Atmospheric deposition of pollutants will be included in the programme as a non-point source of pollution.

Sub-task 3.2 Preparation of a water pollution budget

For the most important water quality parameters the annual loading to the major water courses will be calculated. This will serve as the basis for establishing a water pollution budget for the region.

Results from project 5.2 Water toxicity testing will be used.

Sub-task 3.3 Selection of the most important water pollution sources

Based on the monitoring and an assessment of the pollution sources, the most important point and non-point water pollution sources in the region will be determined. The abatement strategy will be targeted to reduce the most significant water pollution problem.

Sub-task 3.4 Ranking of water pollution sources.

The most important sources to water pollution will be ranked according to their relative importance as pollution sources. The ranking will be based on the amount of pollutants discharged.

Task 4: **Water quality - effect model**

Sub-task 4.1 Development of a "simple" water quality effect model.

The effect model will describe the effects of discharges of the most important pollution substances. The effects on ecology will be quantified. Based on a relative simple model the effects of unloading on the ecology will be described.

Sub-task 4.2 Use of QUAL-IIE model

WRI-O is currently adapting the QUAL-IIE water quality model to some of the water courses in the region. Results from this modelling effort will be used in this study.

Sub-task 4.3 Development of water quality objectives

Based on scientific judgement and participation of decision makers and the public feasible water quality objectives will be proposed for the major water courses. The water quality objectives will be based on Czech and international water quality criteria. Results from project 3.3 will be used in this phase.

Sub-task 4.4 Need for pollution abatement

Based on the proposed water quality objectives and the pollution situation today, the need for water pollution abatement will be defined. The need will be expressed as reduction in tonnes per year for each major water quality parameter.

Task 5: Evaluation of proposed actions

Sub-task 5.1 Selection of study objects

In sub-task 2.3 the most important water pollution sources have been identified. For each of these sources further data might be needed.

Sub-task 5.2 Proposed actions

For each major source to water pollution; i.e. municipal, industrial and agricultural; actions will be proposed to reduce the loading of pollutants. Local technology will be proposed used as far as possible.

For each proposed action solutions will be reviewed and the corresponding reduction in loading will be estimated.

Project "Silesia" will also propose environmental actions and prepare an environmental action programme. Results from this activity will be used in this programme.

Sub-task 5.3 Costs of actions

Investment and O&M costs for each action will be calculated. The costing will be based on European price level. Results from project "Silesia" will be used.

Task 6: **Cost-effective abatement strategy**

Sub-task 6.1 Development of abatement strategy
The next step will be to clarify the costs of each measure and the expected benefits, i.e. reduced discharges of different elements/substances. Based on a comparison of costs and reduction in discharges the cost-effectiveness of each measure can be calculated. This will form the basis for the final abatement strategy.

Sub-task 6.2 Accompanying measures
The strategy will also include proposals for revising the legal, economic and planning framework for environmental protection in the region.

Sub-task 6.3 Proposed environmental priority action programme
The priority action programme will focus on solving the most immediate pollution problems. The action programme will consist of short-term and long-term actions. The programme will include capital and recurrent cost for implementation of actions.

Task 7: **Benefits from the proposed action programme**

Sub-task 7.1 Reduction in pollution load
The resulting reduction in pollution load of each proposed action will be estimated. The reduction in the annual pollution load will also be assessed.

Sub-task 7.2 Local and regional benefits
The local and regional environmental benefits and corresponding improvement in human health will be assessed.

Sub-task 7.3 Benefits on the pollution situation in the Odra River (Poland)
The benefits of the action programme in the water quality in the Odra River at the border with Poland will be assessed.

Task 8: **Reporting**

Sub-task 8.1 The study team will prepare a joint report presenting the findings of the above mentioned tasks and conclusions. The report will be written in English.

6.4 Organisation of the study

NIVA will carry the overall responsibility for timely and professional execution of the proposed study. NIVA will work jointly with WRI-O, IILE and Povodi Odry.

Project team

The project team consists of the following members:

NIVA:	Hans Olav Ibrekk
	Hans Holtan
	Rolf Tore Arnesen
	Jon Lasse Bratli
WRI-O:	Jiri Svercula
Povodi Odry:	Peter Brezina
IILE:	Alexander Skacel

It will also be necessary to collaborate with the Mining University in the proposed sediment sampling.

Transfer of technology and special knowledge will be an important factor during the execution of the study. Therefore it is proposed that all project team members shall work closely during the execution of the study. The activities executed by the Czech team members must be funded locally.

6.5 Work schedule

The study will be executed in 1993 and 1994. Final report will be submitted by November 1994.

The work schedule is presented in table 12.

Table 12. Work schedule for the proposed project.

Activities	1993				1994			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th
1. Environmental status								
1.1 Review of studies	■	■						
1.2 Sampling		■	■					
1.3 Inter-calibration			■	■				
1.4 Assessment				■				
2. Administration								
2.1 Local and regional		■	■	■	■			
2.2 Assessment of instruments				■	■			
3. Pollution sources								
3.1 Inventory of sources		■	■	■				
3.2 Pollution budget				■	■	■		
3.3 Selection of priority sources				■				
3.4 Ranking of sources					■			
4. Water quality - effect								
4.1 Development of water quality model				■	■			
4.2 Application of QUAL-2E		■	■	■	■			
4.3 Setting of water quality objectives					■			
4.4 Need for pollution abatement						■		
5. Evaluation of actions								
5.1 Selection of objects				■				
5.2 Proposed abatement actions					■	■	■	
5.3 Costs of actions						■	■	
6. Abatement strategy								
6.1 Development of strategy						■	■	■
6.2 Accompanying measures						■	■	■
6.3 Action programme							■	■
7. Benefits of the action programme								
7.1 Reduction in load							■	■
7.2 Local benefits							■	■
7.3 Benefits in Odra River							■	■
8. Reporting								
8.1 Status report					◆			
8.2 Final report								◆

6.6 Budget for the study

NIVA's costs will be covered by the Norwegian Ministry of Environment while costs incurred by the Czech participants will be covered by Czech sources.

The budget will include renumeration and expenses (travelling, analysis, etc.) for NIVA's contribution in the project.

The budget for the study is presented in a separate report (application).

REFERENCES

BCEOM. 1992. Prefeasibility study of the Oder/Odra River basin. Draft Synthesis Report.

Industrial Economics 1992. Screening analysis of surface water contamination. Report prepared for Technical Workgroup Project Silesia, Ostrava.

Norwegian Institute for Water Research, 1992. Baltic Sea Environmental Programme. Topical area study for agricultural runoff. Synthesis report.

Water Research Institute of T.G. Masaryk, Ostrava Office. 1991. Prefeasibility study of the Oder/Odra River Basin for the Baltic Sea Environment Programme. First review report and revised work programme.

Water Research Institute of T.G. Masaryk, Ostrava Office. 1991. A list of priorities in the field of pollution. Research programme 05.

Water Research Institute of T.G. Masaryk, Ostrava Office. 1991. Evaluation of water quality in the streams.

ANNEX I

LIST OF INDUSTRIES IN THE OSTRAVA REGION

Industry in the Odra River Basin

No.	Fact. name	English name	Ind. Type	Products	Location
Odra River basin					
001	Lachema Bohumin	Bochemi	Chem	Chloramin, Mercury-	Bohumin
				chloride, Hydrogen-	
				chloride, Diconite	
002	MCHZ Hrusov	Moravian Chemical Works	Chem	Anorg. pigments,	Ostrava
				Active carbon,	
				Sulfuric acid	
003	MCHZ-Dusikarny	Moravian Chemical Works	Chem.	Anilin, Cyclohexanon	Ostrava - Mar.Hory
	/Cerny Pr./			Phenolic resins	
				Addesives based on	
				urea, formaldehyde	
004	MCHZ-Dusikarny				
	/Hl.Opad/				
005	MCHZ-Dusikarny				
	/Odv.Pr/				
006	Optimit Odry	Optimit	Other	Rubber industry	Optimit
007	CSD-VADS Bohumin	Czechosl. State Railway	Other	Evaporation and	Bohumin
				Desinfection	
008	Biocel Paskov	Biocel	Pulp & P.	Pulp mill Mg-sulfite	Paskov
				bleached.	
009	Olsan. Papirny	Olsan Paper Mills	Pulp & P.	Paper manufacturing	Zimrovice
				and processing	
010	NHKG Karvina	New Metallurgical Works	Metal.	Pig Iron, Coke	Kavina
011	NHKG Ostrava VP	New Metallurgical Works	Metal.	Var. kinds of Steel	Ostrava
	/Halda/			products	
012	TZ Trinec	Trinec Iron and Steel Works	Metal.	Coke plant,	Trinec
				Special Steel	
013	Valc. Plechu				
	/Hl.Opad/				
014	Valc. Plechu FM	Sheet mill,	Metal	Sheet mills, Black	Frydek - Mistek

	/Vedl. Opad/			Pickling, Rolling	
015	Vitkovice	Vitkovice Iron and Steel	Metal	Heavy machinery	Ostrava - Vitkovice
	/Cerne Jezero/			Blast furnace, Rolling	
				mills, Pickling, Casting	
016	Vitkovice				
	/Vyr. Z Haldy/				
017	Vitkovice				
	/Kmenova Stoka A/				
018	Vitkovice				
	/Odpopilk. Nadrze/				
019	ZDB Dratovny	Iron and Wire Works	Metal	White cast Iron, Wire	Bohumin
020	ZDB Dratovny NS				
021	ZDB Zelezarny				
022	DUL 1. Maj Karvina	Coal Mine 1. May	Coal mine	Coal mining	
	/Hl. Opad/				
023	DUL 1. Maj Karvina-	Coal Mine 1. May	Coal mine	Coal mining	Karvina
	Zav.Mir				
024	DUL CSM- Stonavia	Coal Mine CSM	Coal mine	Coal mining	Stonavia
025	DUL Dobrava-	Coal Mine Doubrava -	Coal mine	Coal mining	Dobrava -Spluchov
	Upr. Spluchov	Spluchov			
026	DUL Dukla - Havirov	Coal Mine Dukla	Coal Mine	Coal mining, Washing	Havirov
				Nat. gas washing	
027	DUL Sverma	Coal Mine Sverma - Lhotka	Coal Mine	Coal mining	
	Cov Lhotka				
028	DUL Zapotocky -	Coal Mine Zapotocky	Coal Mine	Coal mining	Orlova
	Orlova				
029	DUL Vu Koblov	Coal Mine Vu Koblov	Coal Mine	Coal Mining	Koblov
		Ostrava - Karvina Power			
		Stations			
030	OKE - Csa Karvina	Ostrava - Karvina Power	Power st.	El. and heat prod.	Karvina
		plant - Karvine			
031	OKE - Detmarovice	Power Station Detmarovice	Power st.	Thermal power plant	Detmarovice
032	OKE Trebovice	Power Station Trebovice	Power st.	Thermal power plant	Trebovice
				and heating plant	
033	OKK Sverma	Ostrava- Karvina Coke Plant	Coke pl.	Coke products	Ostrava
034	OKK Vu -Fiebig	Ostrava- Karvina Coke Plant	Coke pl.	Coke products	Ostrava
035	OKK Vu - Rudy Rijen	Ostrava- Karvina Coke Plant	Coke pl.	Coke products	Ostrava

036	OKR - Banske Strojirny				
037	VVUU Radvanice	Sience and Research	Other		Radvanice
		Coal Institute			
038	CEVA Hranice	Cement and lime Works	Other	Cement and Lime	Hranice
039	CMPK Mikulovice	Bohemian - Moravian	Other	Stone Products	Mikulovice
		Stone Industry			
040	Akuma Raskovice				
041	Autopal Novy Jicin	Autopal	Machine	Spare parts - Cars	Novy Jicin
042	Branecke Zelezarny	Bastro	Machine	Mining Mach. Rep.	Ostrava
043	Elektropraga Hlinsko	Elektropraga	Machine	Electrical appliances	Jablunkov
	Jablunkov				
044	Koh-I-Noor	KOOH-I-NOOR	Machine	Met. buttons etc.	Bilovec
	Bilovec				
045	Kovohute Bridlicna				
046	Tatra Koprivnice	Tatra	Machine	Cars	Koprivnice
047	Galena Komarov	Galena	Pharm.	Pharm. prod.	Opava - Komarov
Luzicka Nisa River Basin					
001	Autobrzdy	Autobrakes	Machine	Car brakes?	Jablonec n.K.
	Jablonek n.N.				
002	Liaz,	Liberec Automobile Plant	Machine	Cars ?	Jablonec n.K.
	Zav. jablonec n.N.	Plant Jablonec			
003	Praga				
	Zav. Hradek n.N.				
004	Kolora, Zav. Liberec	Kolora	Textile	Washing, Coloring,	Hradek
				Finishing	
005	Tesla Liberec, Zav.				
006	Straz n.N.				
007	Spolek pro Chem.	Ass. for Chem. and	Chem.	Textile Helping	Mnisek u Liberce
	A Hutni Vyrobu zav.	Smelting Production		Preparations	
	Mnisek u Liberce				
008	Textilana Liberec,	Textilana, Plant Chrastava	Textile	Washing, Coloring,	Liberec
	Zav. Chrastava			Finishing	
009	Preciosa Jablonec	Preciosa -Plant Minkovice	Other		Minkovice
	Zav. Minkovice				
010	Bonar				
	Zav. Hradek n.N.				

011	Kolora	Kolora	Textile	Washing, Coloring,	Hradek n.N.
	Zav. Hradek n.N.			Finishing	
012	Seba, Zav. Liberec	Seba	Textile	Coloring, Finishing	Liberec
013	Stredoceska Zridla				
	Zav. Vodtislavice n.N.				
Smeda River Basin					
001	Drevarske Zavody	Timber Plant	Pulp &P.	Wood Working	Cernousy
	Zav. Cernousy				
002	Bytex	Bitex - Plant Vez u	Textile		Ves u Frydlantu
	Provoz ves u Frydlantu	Frydlantu			
003	Textilana	Textilana - Plant Nove	Textile	Washing, Coloring	Nove Mesto p. Sm.
	Zav. Nove Mesto p.	Mesto p.Sm.		Finishing	
	Smrkem				
004	Tiba. Zav. Frydlant	Tiba	Textile	Washing, Coloring,	Frydlant v Cechach
				Finishing	

ANNEX 2

RESULTS OF THE SAMPLING PROGRAMME. WRI-O

WATER RESEARCH INSTITUTE T. G. M.
BRANCH OSTRAVA

RESULTS OF SIMULTANOUS TAKING SAMPLES IN ODRA CATCHMENT AREA

Tab.1

River Profile	Ostravice below res.	Ostravice Vratimov	Bilovka Bilovec	Odra Polanka	Odra Trebovice
pH	7.0	8.4	7.7	7.9	8.1
Turb ZF	2.2	6.7	17.0	26.8	8.9
A^{1cm}_{560}	0.025	0.075	0.19	0.30	0.10
Cond mS/m	10.79	35.94	56.75	55.64	38.13
NO_3 mg/l	6.3	9.5	1.8	14.7	11.7
NO_2 mg/l	0.00	0.71	0.49	0.43	0.37
SO_4 mg/l	21.8	71.2	63.2	71.4	53.3
PO_4 mg/l	0.00	0.48	1.00	0.14	0.45
Tot-N mg/l	3.0	6.3	13.5	8.0	6.5
Tot-P mg/l	0.02	0.42	2.80	0.49	0.65
NH_4 mg/l	0.05	0.78	14.6	0.79	0.62
Mg mg/l	3.7	6.7	16.4	10.3	9.7
Ca mg/l	14.0	44.1	49.1	63.1	42.1
Cd mg/l	<0.0005	0.0008	0.0008	0.0008	0.0008
Cr mg/l	<0.005	<0.005	0.008	<0.005	0.005
Cu mg/l	<0.002	0.004	0.06	0.006	0.004
Fe mg/l	0.06	0.23	0.65	1.45	0.68
Mn mg/l	0.045	0.045	0.36	0.32	0.14
Ni mg/l	<0.003	0.006	0.083	0.006	0.003
Pb mg/l	0.01	0.013	0.01	0.01	0.013
Zn mg/l	0.014	0.035	0.11	0.12	0.043

Tab.2

River Profile	Ostravice Muglinov	Odra Petrkovice	Odra Bohumin	Olse Vernovice	Olse under Trinec
pH	7.7	7.7	7.5	7.6	7.9
Turb ZF	17.4	18.7	22.3	8.5	12.5
A^{1cm}_{560}	0.195	0.21	0.25	0.095	0.14
Cond mS/m	130.7	54.1	117.2	657.5	64.1
NO_3 mg/l	16.2	18.8	15.1	10.4	6.8
NO_2 mg/l	0.70	1.17	0.64	2.36	0.33
SO_4 mg/l	296.2	83.3	197.1	128.6	91.5
PO_4 mg/l	0.41	0.61	0.32	0.29	0.45
Tot-N mg/l	14.0	13.4	13.9	10.0	14.8
Tot-P mg/l	0.59	1.04	0.72	0.88	0.75
NH_4 mg/l	3.33	3.79	5.87	6.66	14.46
Mg mg/l	30.4	11.6	24.3	76.6	11.6
Ca mg/l	100.2	52.1	78.2	198.4	54.1
Cd mg/l	0.0018	0.0008	0.0028	0.0055	0.0013
Cr mg/l	0.008	0.005	0.008	0.010	0.005
Cu mg/l	0.007	0.005	0.006	0.008	0.008
Fe mg/l	0.98	0.75	1.40	0.58	0.45
Mn mg/l	0.24	0.25	0.29	0.30	0.15
Ni mg/l	0.013	0.008	0.010	0.026	0.009
Pb mg/l	0.018	0.013	0.023	0.038	0.020
Zn mg/l	0.140	0.065	0.650	0.070	0.230

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ISBN-82-577-2233-2