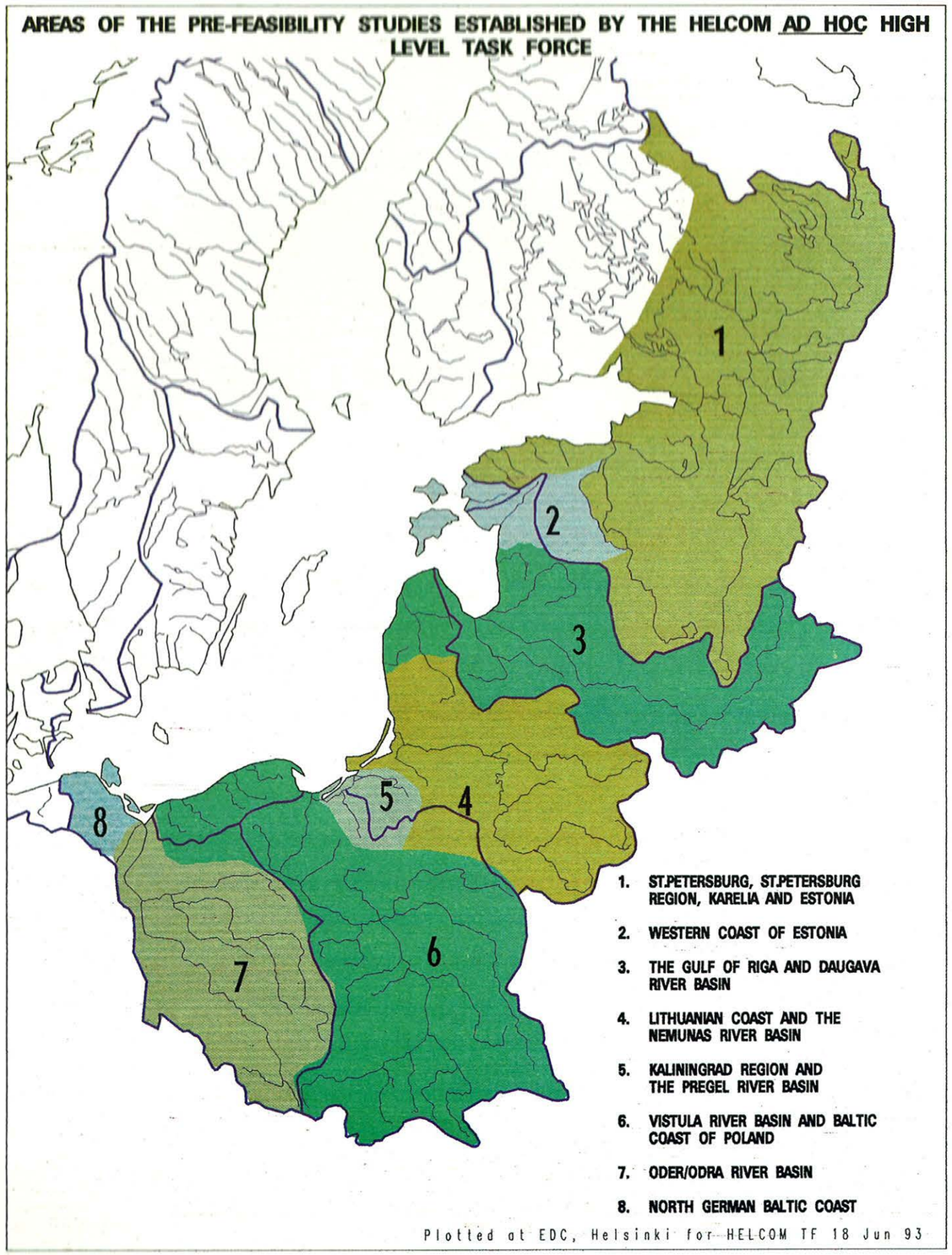
BALTIC SEA ENVIRONMENT PROCEEDINGS

No. 46

SUMMARIES OF THE PRE-FEASIBILITY STUDIES

Prepared for the Baltic Sea Joint Comprehensive
Environmental Action Programme

BALTIC MARINE ENVIRONMENT PROTECTION COMMISSION
– HELSINKI COMMISSION –



BALTIC SEA ENVIRONMENT PROCEEDINGS

No. 46

SUMMARIES OF THE PRE-FEASIBILITY STUDIES

Prepared for the Baltic Sea Joint Comprehensive
Environmental Action Programme

BALTIC MARINE ENVIRONMENT PROTECTION COMMISSION
– HELSINKI COMMISSION –
1993

For bibliographic purposes this document should be cited as:
HELCOM, 1993
Summaries of the Pre-Feasibility Studies
Prepared for the Baltic Sea Joint Comprehensive
Environmental Action Programme
Balt. Sea Environ. Proc. No. 46

ISSN 0357-2994

Helsinki - Painatuskeskus Oy

TABLE OF CONTENTS

432491U

PREFACE

In the elaboration of the Baltic Sea Joint Comprehensive Environmental Action Programme pre-feasibility studies and consultant reports were prepared on a number of priority areas. This publication contains summaries of eight pre-feasibility studies, the topical area study for agricultural runoff and the study on wetlands. The international financial institutions (European Bank for Reconstruction and Development, European Investment Bank, Nordic Investment Bank and the World Bank) and the Commission of the European Communities acted as executing agencies within the HELCOM ad hoc high level Task Force for the preparation of the studies. A reference list of the pre-feasibility studies and topical area studies is attached to this publication.

The strategy and principles for a long-term programme to restore the ecological balance of the Baltic Sea (the Baltic Sea Joint Comprehensive Environmental Action Programme) was adopted by the Diplomatic Conference on the Protection of the Marine Environment of the Baltic Sea Area, held in Helsinki on 9 April 1992, published in the BSEP No. 48. The Summary of the Programme, as in Conference Document No. 5/2 of the above mentioned Diplomatic Conference "Background Document for the Baltic Sea Environmental Declaration, 1992", is also included in this publication.

A. BACKGROUND DOCUMENT FOR THE BALTIC SEA ENVIRONMENTAL DECLARATION, 1992

DIPLOMATIC CONFERENCE ON
THE PROTECTION OF THE MARINE ENVIRONMENT
OF THE BALTIC SEA AREA

Helsinki, Finland
9 April 1992

Conference Document No. 5/2

Agenda Item 5

BACKGROUND DOCUMENT FOR THE BALTIC SEA ENVIRONMENTAL DECLARATION, 1992

Conference Secretariat
Helsinki Commission

in cooperation with
Ministry for Foreign Affairs of Finland and Ministry of the Environment of Finland

BACKGROUND DOCUMENT

FOR THE BALTIC SEA ENVIRONMENTAL DECLARATION, 1992

I. INTRODUCTION

1 The Diplomatic Conference on the Protection of the Marine Environment of the Baltic Sea Area is invited to adopt the draft Baltic Sea Environmental Declaration, 1992, endorsing the strategic approach and principles of the Joint Comprehensive Environmental Action Programme (Preliminary version) which was developed to respond to the Baltic Sea Declaration adopted at the level of Prime Ministers at the Baltic Sea Environment Conference in Ronneby, Sweden on September 3, 1990.

2 At Ronneby, the Ministers established the long-term objective of ensuring the ecological restoration of the Baltic Sea and the preservation of its ecological balance. The Programme addresses these issues by identifying problems and priority actions in all the countries within the Baltic Sea catchment area (Fig.1).

II. OVERVIEW

3 The multi-year Programme encompasses both preventive actions to promote sustainable use of the Baltic environment, and curative actions to rectify the legacy of environmental degradation from point and non-point source pollution. In addition to these investments, the Programme will support development of appropriate environmental policies and legislation, promote the use of economic incentives to encourage environmentally sound actions, strengthen institutional capacity and human resources, and increase the local capacity to finance environmental measures.

4 The Programme has been designed to support implementation of the Helsinki Convention and HELCOM Recommendations. Priorities include investment and non-investment actions to address the need to control both non-point source pollution and point source pollution. The Programme identifies actions needed to control pollution at 132 "hot spots" (Fig. 2). Of these 47 have been designated "priority hot spots". The latter are a primary focus of the first phase of the investment programme.

III. BACKGROUND

5 The Programme has been elaborated by the ad hoc high level Task Force established within the framework of the Helsinki Commission (HELCOM TF). The members of HELCOM TF are all the Contracting Parties to the Helsinki Convention

(Denmark, Estonia, Finland, Germany, Poland, Russia, and Sweden), the Czech and Slovak Federal Republic, Latvia, Lithuania, Norway and the Commission of European Communities (CEC), as well as four multilateral financial institutions - the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB), the Nordic Investment Bank (NIB), and the World Bank. The International Baltic Sea Fishery Commission participated as an observer. Greenpeace International, World Wide Fund for Nature (WWF) and the Coalition Clean Baltic (CCB) have had an opportunity to comment on the draft pre-feasibility studies and the draft Joint Comprehensive Environmental Action Programme.

6 The Task Force used a variety of studies and sources of information to develop the Programme. These included national plans prepared by the States, who are Contracting Parties to the Helsinki Convention, as well as by the Czech and Slovak Federal Republic, Latvia, Lithuania and Norway which were reviewed by the Task Force. Pre-feasibility studies were undertaken of environmental issues, the sources and magnitude of pollution loads, and options for pollution control and improved environmental management throughout the Baltic Sea catchment area. Special studies were also made of agricultural runoff, wetlands, and the impact of emissions into the atmosphere. Preparation of the pre-feasibility studies included holding public hearings at a number of locations in the eastern and southern portions of the region. It should be noted, however, that some of the studies launched by the Task Force have not yet been completed in technical detail. The pre-feasibility studies and special studies were financed by grants totalling about 5 million ECU from the Commission of the European Communities, Denmark, Finland, Germany, the Nordic Project Export Fund (NoPEF), Norway, Sweden and the World Wide Fund for Nature (Sweden).

7 The preliminary version of the Joint Comprehensive Environmental Action Programme has had only a limited review by those representatives present at the last meeting of the Task Force in March 1992. A more profound examination by the respective national authorities will be required before finalization of the Programme, which is intended to follow soon after the Diplomatic Conference.

IV. DEGRADATION OF THE BALTIC SEA

8 As late as 1950 the Baltic Sea was still regarded as environmentally "healthy". Large-scale industrialization throughout the basin had not yet made its impact, automobiles were few, and intensive agriculture and forestry, based on a heavy use of chemical fertilizers, was only commencing. Since then the situation has changed considerably. Pollution now threatens the entire Baltic Sea catchment area as well as the Baltic Sea itself, and ultimately the health and well-being of the 80 million people who live there.

9 **Natural Vulnerabilities.** The Baltic Sea is naturally vulnerable to pollution due to its semi-closed character and particular hydrography. The shallow, narrow Belts and the Sound permit only a slow water exchange between the Baltic Sea and the North Sea. As a result, the water in the Baltic Sea has a long residence period of between 25 to 40 years, which promotes the accumulation of pollutants. Due to this limited and irregular saltwater replenishment from the North Sea as well as its large catchment area, the Baltic Sea is dominated by freshwater inputs. The vertical variations in salinity cause permanent stratification hampering the exchange of oxygen in some parts of the Baltic Sea. In the lower layers of these areas, decomposition of organic material leads to anoxic conditions, rendering these layers virtually lifeless. The size of the bottom areas with impaired conditions for life varies from year to year. In some years as much as 100 000 km^2, or one fourth of the whole Baltic Sea, approaches "dead bottom" conditions.

10 **The Human Contribution.** The natural vulnerability is seriously aggravated by anthropogenic causes of environmental change and degradation. Municipalities and industries in the catchment area discharge pollutants directly to the numerous rivers that feed into the Baltic Sea, and to the many estuaries, bays and gulfs. Rivers act as large-scale collectors and carriers of wastewater from diverse sources within their drainage basins and discharge them into wetlands, coastal lagoons and the Baltic Sea. The inadequate treatment of municipal sewage in the eastern and southern and southwestern parts of the catchment area is compounded by lack of pre-treatment of industrial wastewaters that are discharged to the municipal sewage systems. In addition, many pollutants are transported to the Baltic Sea through the atmosphere. Finally, agricultural practices, including intensive livestock husbandry, are a major contributor to the high nutrient load on the Baltic Sea.

11 **The Contribution of Large Nutrient Loads.** Eutrophication is a problem of special concern. Eutrophication is caused by excessive growth of biomass stimulated by the large influx of nitrogen and phosphorus compounds which come from agricultural and forestry runoff, atmospheric transport, as well as discharges from municipalities and industries. The decay of this vast biomass causes oxygen depletion and threatens marine life. At present, the approximate annual load into the Baltic Sea is some 1 000 000 tons of nitrogen and 50 000 tons of phosphorus. About 30 percent of the total load of nitrogen emanates from atmospheric deposition. These loading levels represent three times the level of the 1950s. Eutrophication is especially observed in the Gulf of Finland, the Gulf of Riga, and in coastal areas of the eastern, southern and southwestern Baltic Sea. A significant source of the nitrogen input is from either atmospheric deposition directly to the Baltic Sea or assimilated from atmospheric nitrogen. Much of the pollution load originates from sources outside the Baltic region and calls for efforts to reduce long-range transboundary pollution.

12 **The Accumulation of Toxic Substances.** Although concentrations of heavy metals in fish and shellfish have not increased significantly since the early 1980s, the concentrations of cadmium, lead, copper and nickel are higher than the background values and those in the North Sea biota. Potentially toxic metals (cadmium, mercury, and lead) have been accumulated in sediments in remobilizable form which could be quickly released due to oxidation following strong saltwater inflows to the bottom layer. Currently, annual loads of 2500 tons of lead, and 25 tons of mercury are deposited into the Baltic Sea. The ban on the use of some use of some persistent toxic organic compounds such as DDT and PCBs has led to a significant decrease in the biota since 1974. The decrease in the discharges of organo-chlorine compounds, and in the use of mercury and other heavy metals in some applications in response to HELCOM Recommendations, as well as decisions on pesticide use, will help to stem the increasing risk of these substances.

13 **The Pollution Legacy.** At the same time, there is a legacy of pollutants and degradation from earlier industrial practices and the lack of adequate municipal wastewater treatment facilities in many parts of the Baltic Sea catchment area. Large numbers of cities and towns dump their untreated wastewater directly into the region's rivers and coastal waters. The pulp and paper industry has played a major role in the discharge of oxygen

consuming, nutrient rich, slowly degradable and toxic substances. Large-scale industrial centers, such as St. Petersburg in Russia, Upper Silesia in Poland and Ostrava in Czechoslovakia, have also contributed to pollution of the Baltic Sea through air pollution and wastewater discharges. In addition to air pollution sources located within the catchment area of the Baltic Sea, many sources of air pollution located outside the catchment area, even at great distance, affect the Baltic Sea, depending on wind direction. Moreover, each year three to four million tons of hazardous and toxic waste of industrial origin are placed in landfills in the Baltic Sea catchment area. Without proper controls and safe disposal, much of this waste may eventually end up untreated in the Baltic Sea through leakage and open-air burning.

14 **Underlying Causes.** It must be acknowledged that underlying these damaging environmental practices are a host of underlying causes of economic and political character, such as inadequate economic policies, inefficient economies, legislation without appropriate enforcement mechanisms, weak institutional arrangements and poor planning practices. These causes vary in character and degree in each of the countries of the Baltic Sea catchment area.

V. STRATEGY AND SOLUTIONS

15 **Key Concerns in the Formulation of a Strategy.** The aim of the strategy is to address the common need to protect and restore the Baltic Sea. The primary constraint to the realization of these objectives is the limited capacity of many of the concerned countries to finance improvements in environmental management and accompanying measures to control pollution. The success of the environmental strategy will depend on a series of national interventions that must compete with other priority areas for allocation of human and financial resources, especially in the formerly centrally planned economies of the Baltic Sea region. In the eastern and southern portions of the Baltic Sea region, an institutional and economic restructuring process is underway -it will not be possible to implement an effective environmental strategy independent of this process of political, economic and administrative change. The ultimate goal should be to comply with the environmental standards of the European Communities or, where applicable, with other stricter standards.

16 **Key Principles On Which The Strategy is Based.** A consensus on a comprehensive strategy is needed for joint and co-ordinated action to reverse these conditions. A long-term perspective is the cornerstone of the formulation of a strategy to solve the environmental problems of the Baltic Sea region. In this long-term context, the development pattern and the choice of environmental management measures must be sustainable in order to restore and maintain the ecological balance. The strategy should encompass both preventive and curative measures, directed at supporting the Helsinki Convention and the HELCOM Recommendations, and with respect to the precautionary principle. Pollution should be controlled at the source in order to prevent the generation of environmentally damaging wastes and to improve the cost effectiveness of environmental management. Solving pollution problems at the source can also create new opportunities to expand the role of private investment in improving environmental management, particularly where investment in new process technology will also minimize waste. While significant progress has been made in general in addressing environmental issues in the Baltic Sea region over the last few decades, many years of work remain in parts of the Baltic Sea catchment area to reverse past trends and prevent potential future problems.

VI. THE JOINT COMPREHENSIVE ENVIRONMENTAL ACTION PROGRAMME

17 **Strategy.** The preparatory work of the Task Force has demonstrated that curative actions are necessary in all the Baltic countries. Many actions that contribute directly to achieving the goals of the Programme have already been undertaken or are underway in most of the countries. There is ample evidence of the need to support these ongoing activities, particularly implementation of the new environmental policies being formulated and adopted in the formerly centrally planned economies. Support is especially needed for capital investment in actions to overcome the pollution legacy and build the infrastructure required for effective environmental management.

18 The Programme strategy to restore the ecological balance of the Baltic Sea and its catchment area addresses these needs through actions by each concerned government to carry out policy and regulatory reforms, capacity building, and capital investments to control pollution from point and non-point sources, eliminate or reduce the generation of waste, and conserve environmentally sensitive and economically valuable areas. In the countries of the eastern and southern parts of the region, Programme actions will be phased to keep pace with the gradually increasing capacity for project finance of these transforming economies. In the first years, emphasis will be placed on policy reform, limited public investment in the highest priority projects, and promotion of private investment and initiative through concessions and incentives. Environmental investment programmes in the northern and western portions of the basin will also form an integral part of the strategy.

19 **Policy and Regulatory Measures.** This component of the Programme focuses on putting in place the policies and regulatory measures that establish a long-term framework and system of incentives and legal requirements. This new policy and regulatory framework will lead to incremental improvements over a period of two decades or more. Policies should support clear and practical goals and be consistent with the evolving macroeconomic policy and institutional framework in each country. Regulatory measures including environmental standards, among others, those adopted in HELCOM Recommendations, should be consistent with prevailing economic conditions and environmental values, and should lead to the phased achievement of regional objectives over the long term. Initiatives will include:

- Develop environmental policies, laws and regulations;
- Revise and harmonize environmental standards and guidelines, on a regional and national basis;
- Implement the Polluter Pays Principle and adopt realistic user charges;
- Devise and implement effective systems and mechanisms for assessment and collection of local revenues to finance environmental improvements.

20 **Institutional Strengthening and Human Resource Development.** The Programme also focuses on: strengthening the institutions and human resources needed to enforce regulations; planning, designing, and implementing environmental measures; and managing natural resources efficiently. Efficient management of natural resources may be considered a prerequisite for stable productivity and optimum yield of fishery resources. The strategy includes support for:

- Strengthened management and planning capacity of national and local environmental authorities;
- Support for development of effective water, wastewater and solid waste management utilities;
- Implementation of effective systems for environmental monitoring, data collection and analysis;
- Revision of economic plans and management approaches with a view to restructuring such sectors as energy and industry to be more environmentally friendly;
- Case by case implementation of Best Environmental Practice and Best Available Technology; and
- Expansion of applied research.

21 **Investment.** The Programme encompasses a multi-year investment programme of specific measures to control and manage point sources, non-point sources, and conserve environmentally sensitive areas and resources. Arrangements to finance and implement projects identified in the Programme will require more detailed feasibility studies. These feasibility studies clearly mark the critical path for Programme implementation. But these studies will only be undertaken where there are real probabilities of implementation. Two key conditions that need to be met are the availability of project sponsors and their willingness to invest within a sufficiently short time horizon to insure that a feasibility study undertaken over the next year or two will remain valid for the period of implementation of the project. Concurrently, the Programme will actively support as a high priority the strengthening of local capacity to finance Programme investments.

22 Investment priorities are determined primarily by the character and magnitude of the impact, particularly on public health and ecology, and the economic feasibility and effectiveness of the proposed interventions. The major constraint affecting the setting of priorities, and the choice and sequencing of investments, is the limited capacity to mobilize financial resources to meet capital and recurrent costs. As noted above, the strategy encompasses initiatives to help relieve this constraint. Nevertheless, it is expected to be a critical factor in the early stages of Programme implementation. These considerations will dictate a phased approach in which each investment is an incremental, planned and integral part of an overall system to be developed over the longer term. Control of point sources will focus on "hot spots," areas of acute environmental concern, where pollution has the largest impact on the Baltic Sea and its catchment area, and appropriate actions are most cost-effective.

23 **Point Source Pollution.** The focus of specific investments and other measures to control point sources includes:

- Rationalization of water consumption and network upgrading;
- Municipal and industrial wastewater treatment with adequate pre-treatment of industrial wastewater in combined systems;
- Environmental control of industrial sites with direct discharges (e.g. pulp and paper production, chemical industry, metal plating);
- Air quality management at selected stationary sources; and
- Solid and hazardous waste management, including generation and disposal.

24 **Non-point Source Pollution.** Control of non-point sources of pollution, particularly from agriculture, forestry, transportation and products containing hazardous substances which might be disposed of in landfills or burned in incinerators, will be promoted by more effective regulation, appropriate systems of incentives, and expanded availability of effective low-cost technology for improved environmental management. This should include air quality management for area sources (phasing out of leaded fuels and reduction of NO_x from mobile sources and ammonia from agriculture). The strengthening of agricultural extension services, conduct of applied research programmes for fertilizer and pesticide application and access to improved agricultural equipment will be required as elements of the Programme actions to address agricultural run-off. This approach will also be supported to promote and improve environmental management by the numerous large livestock operations in the Baltic Sea catchment area. Increased applied research and exchanges of information concerning physical, chemical and biological systems in the Baltic Sea region will be supported to improve the monitoring and understanding of changes and impacts.

25 **Management Programmes for Coastal Lagoons and Wetlands.** The programme will support the establishment of comprehensive programmes in environmentally sensitive areas including the large coastal lagoons and wetlands. Especially as wetlands may play an essential role in reducing the nutrient loads to the sea from diffuse sources in agricultural areas, whereas their use as waste water treatment plants cannot be recommended. These programmes will be developed through the preparation of management plans in collaboration with concerned Governments, local authorities, international organizations, and specialized non-governmental organizations such as World Wide Fund for Nature (WWF) and International Union for the Conservation of Nature (IUCN). Programme activities include land acquisition, compensation, land and facility development, and control measures.

26 **Increasing Public Awareness, Environmental Education and Political Commitment.** This component of the Programme aims at developing a broad and sustainable base of support for the implementation of Programme actions. The participation of non-governmental organizations and the development of effective environmental education programmes will be important in supporting both public awareness and political commitment. The Programme will support public awareness and environmental education activities to develop widespread understanding and popular support for the long-term activities required to restore the ecological balance of the Baltic Sea, its coastal zone, and

catchment area. These activities are vital to the development of a "political constituency" willing to accept the measures needed for this restoration, such as increased user fees and taxes. Programme funding could be made available to support participation of nongovernmental organizations in reaching out to the "grass roots" level. Special funding could also be required for mass media campaigns to support and promote the objectives of the Programme. Efforts to promote and expand environmental education, particularly in the context of local environmental clean-up activities, should be given priority.

VII. THE EXPECTED ENVIRONMENTAL BENEFITS OF THE PROGRAMME

27 **The Necessity for a Long-Term Perspective.** Implementation of the Programme will necessarily require decades. Given the long-term pattern of periods of stagnation in the Baltic Sea and their negative consequences for the condition of its ecosystems, major sustained impact on the Baltic Sea environment cannot be expected for less than a generation. Nevertheless, gradual and visible improvements can be expected, and locally, major economic and important environmental benefits can be realized in the relatively near term.

28 **Clean-up of the Rivers.** The Programme is also expected to have major economic and environmentally beneficial impacts on the rivers of the Baltic Sea catchment area. The region's rivers are presently the major source of water supply for domestic and industrial use. Large investments in water treatment have been and will be required due to severe pollution and ecological deterioration. Reductions in pollution loads and restoration of river ecosystems through implementation of the Programme will lower water treatment costs, increase the reliability and quality of water services by reducing the load on frequently overtaxed treatment facilities, and decrease groundwater depletion and saltwater intrusion in coastal areas. The framework of incentives adopted under the Programme will lead to reduced water consumption that will not only lower the cost of wastewater treatment but also help to defer costly investment in new water supplies, particularly in sensitive coastal areas. The general improvement in the quality and reliability of potable water supplies will have significant benefits for the health and well being of the people.

29 **Clean-up of the Coastal Waters.** Coastal waters can be expected to improve most rapidly. The current widespread closure of beaches in the southern and eastern part of the Baltic Sea due to contamination from untreated wastewaters, odours, and massive algal blooms has caused serious loss of hard currency income and employment from tourism as well as local recreation opportunity. Treatment of municipal and industrial wastewaters and other inputs containing potentially pathogenic bacteria, viruses and other harmful organisms will allow the beaches to open again and contribute to establishing favourable conditions for new investment in this important sector.

30 **Reduction in Nutrient Loads.** The nutrient loads that have caused extensive eutrophication and upset the riverine and marine ecosystems will be reduced mainly by improved environmental management in the agriculture and livestock sectors, decreased atmospheric pollution, and expanded and more efficient municipal and industrial wastewater treatment. Conservation and improvement of wetlands is also expected to have a significant impact on nutrient loads and will contribute as well to an increase in biodiversity. These nutrient load reductions will have widespread beneficial impacts on health, environmental values, and significant economic benefits through reductions in costs and improved conditions for investment. It is however important to note that the long-range transportation of nitrogen from areas outside the catchment area of the Baltic Sea has a big impact.

31 **Restoring Ecological Balance in the Baltic Sea.** Restoring the quality of the open waters of the Baltic Sea will be considerably slower, in part for the reasons noted above. The overall reduction in the load of nutrients brought about by greater pollution control under the Programme will reduce algal production and possibly make algal blooms less frequent. With decreased eutrophication and sedimentation, oxygen conditions will improve. These changes can be expected to have a major positive impact on fishery resources in the coastal waters and in the open sea. Benefits in this sector will include an increase in the number and diversity of fish species, and, equally important, increases in the number of commercially valuable species such as white fish, cod and plaice. Control of environmental degradation in riverine area should allow salmonid species to reappear in these areas.

32 **Strategic Gains from Capacity Building.** A quite different but strategically important benefit will stem from the strengthening of local capacity to plan, finance, and manage the measures required under the Programme, and from the transfer of know-how that will have long-term benefits for environmental management. The latter includes, for example, environmental audits, financial management at the local level, improvements in industrial management, and improved agricultural practices.

VIII. THE COSTS AND FINANCING OF THE PROGRAMME

33 Unprecedented political and economic changes have affected the entire Baltic Sea region since the Ronneby Conference in September, 1990. The implications for the financing of the Programme are grave. The formerly centrally planned economies are going through a dramatic economic restructuring, which has in the short run limited their creditworthiness and reduced capacity to produce goods and services. The acute demands for basic items such as energy, food and medicine will undoubtedly impede the financing needs of the Programme over the medium-term. In addition, some of the potential donor countries are suffering a protracted recession. Realistically, if Programme implementation is to begin in 1993, financing from a diversity of foreign sources will be essential, with a high share in the form of loans from the international financial institutions. Over time, the emerging market economies should be able to assume an increasing share of Programme financing.

34 **Investment Cost of the Programme.** Implementation of the entire long-term Programme is estimated to cost at least 18.0 billion ECU over a twenty year period (Table 1). It will be implemented in two phases: the first phase (1993-1997) is estimated to cost 5.0 billion ECU; the second (1998-2012) is estimated at an additional 13.0 billion ECU. This Programme will include support for development of policy and regulatory reform, institutional strengthening, and investment actions.

35 The Programme will focus on 132 "hot spots". As described in detail in the Joint Comprehensive Programme, these "hot spots" comprise actions to address point and non-point source pollution in the Baltic Sea catchment area, and are estimated to cost about 10.0 billion ECU (Tables 2 and 3).

36 Of the 132 "hot spots", the Task Force has identified 98 actions at key "hot spots" in Russia, Estonia, Latvia, Lithuania, Belarus, Ukraine, Poland and the Czech and Slovak Federal Republic, out of which 47 have been identified as "priority hot spots". The cost for these 98 actions is estimated at 8.5 billion ECU. Of the 8.5 billion ECU, 6.5 billion ECU will cover the 47 "priority hot spots". In the case of Poland, which is the most populated country and the largest single polluter in the catchment area, the estimated cost for the 40 recommended actions, at both "hot spots" and "priority hot spots", exceeds 4.0 billion ECU. The remaining 34 actions at sites in Denmark, Finland, Germany and Sweden have been selected by the countries concerned and have an estimated cost of approximately 1.5 billion ECU.

37 **Other Programme Costs.** There are other substantial and important costs which should not be overlooked in considering the overall financing needs of the Programme. First, feasibility studies of the highest priority projects must be carried out in order to complete financing arrangements. These studies have been estimated to cost at least 30 million ECU. However, the key constraint to undertaking this critical step is not likely to be funds or external support, but rather the identification of project sponsors willing and able to finance and manage the projects. Second, the respective Governments in the eastern and southern parts of the Baltic Sea region will need to incur substantial local costs in facilities, services, and human resources to develop and carry out the required policy and regulatory reforms, institutional strengthening, and planning and programming initiatives on which the smooth and timely implementation of the Programme will critically depend. Considerable external support for these activities is likely to be forthcoming, but the local commitments of staff, organization, and financial resources will remain substantial.

38 **Need for External Assistance.** Nearly two-thirds of the "hot spots" are located in countries whose combined population numbers about 60 million, and whose macroeconomic situation has often led to problems with creditworthiness, making ordinary loans and commercial financing difficult. These profound economic problems are expected to improve only slowly. The absence of creditworthy borrowers - either sovereign or individual - constitutes a great challenge and threat to the timely implementation of the Programme. It is already obvious that the Programme will have to depend upon a multiplicity of financing sources for its implementation. In mobilizing diverse sources of financing, sometimes for a single project, the sharing of financial risks will be an important principle. Official support and participation in project capital financing in such cases could take the form of sovereign guarantees that assume a part of the financial risk. This approach to public participation in project financing may also have the beneficial effect of lowering the overall cost of financing.

39 **Need for Varied Approaches to Project Financing.** Despite the recessions and tight budgets in the wealthier countries, and fierce competition among regions for the resulting limited international development assistance, some combination of normal and concessional development lending, supplemented by outright grants, will be needed from the bilateral and international financing agencies lest the bulk of the Programme remain only a dream. Moreover, the concerned Governments will need to adopt a number of strategies to finance the Programme and overcome the limitations of slow growth, tightly constrained budgets, and competition for limited financial resources from other important and productive sectors. These strategies may include enhanced local sources of revenue from taxes and user charges; earmarked revenues from fines, permits, and user taxes on potentially

polluting substances such as fertilizers and pesticides; and private sector investment supplementing traditional public sector borrowing and budgetary resources. The approaches to project financing must often be accompanied by policy and regulatory reforms that establish adequate authority, effective mechanisms and appropriate incentives.

40 **The Industrial Sector.** The greatest opportunity to shift the burden of environmental financing away from the public budget, and reduce the absolute cost of environmental management, is to incorporate pollution control at the source into the industrial privatization, restructuring and modernization process that is an integral part of the ongoing transition to a market economy in the eastern and southern portions of the Baltic Sea region. Of course these environmental investments are clearly conditional on each industrial enterprise's economic and financial viability. Under the ongoing and evolutionary macroeconomic reform process, with its fundamental changes in prices and supply/demand relationships, the viability of industries is being redefined. All investments in industry, including those for environmental improvements, are therefore largely determined by this restructuring process. Each project will have to be decided on its own merit, which might mean that some polluting and economically non-viable industries should be closed.

41 **The Municipal Sector.** Responsibility for key public services including environmental management has almost entirely devolved to local government. There has been a break with the past pattern of heavily subsidized and inefficient operations that predominated in planned economies. These changes have presented the municipal authorities with new requirements in terms of modern management in all technical and financial aspects of their operations. The imposition of user charges following the Polluter Pays Principle is one possibility of paying for at least operation and maintenance costs of environmental management facilities such as wastewater treatment plants. However, more innovative approaches such as joint ventures and long term concessions may be needed to attract capital financing, particularly from private and commercial sources. Limited government participation through guarantees and subsidies, may be needed, at least for the mid-term, until users and local authorities are better able to support direct financing. The use of contracts between municipalities and private sector firms for the management and operation of water, wastewater and solid waste facilities presents an important opportunity to decrease demands on municipal government and improve performance. It is also important to maintain and develop the public transport system which plays a central role in the shaping and implementation of a comprehensive air pollution control policy.

IX. IMMEDIATE ACTIONS TO BE TAKEN

42 **Immediate Actions to Implement the Programme.** Since, as noted earlier, implementation of all the identified actions will take several decades, a phased approach will be required. Each phase will include a concrete programme of investment, policy reform, and institutional strengthening actions. A programme for Phase I, covering the period 1993-1997, is outlined below. Formulation of subsequent phases will address the highest priority actions that remain to be implemented, with adjustments and modifications based on experience gained in the earlier phase. Additional actions, which although potentially important, were not included in the list of "hot spots" prepared for Phase I, will be included in Phase II. The second phase of the Programme will also incorporate important actions identified during the implementation of Phase I, particularly in the area of solid and

hazardous waste management. Later phases of the Programme could be expected to place increased emphasis on industrial pollution control activities, following the results of industrial and energy restructuring in the formerly centrally planned economies.

43 **The Phase I Investment Programme.** There are four principal investment priorities during Phase I:

(a) Emergency support and systems. To avoid serious public health risks and increased pollution of rivers and coastal waters, immediate support is needed to overcome the shortage of chemicals, replacements, and spare parts required for the continued operation and maintenance of water supply and treatment, and wastewater treatment facilities in Belarus, Estonia, Latvia, Lithuania, Russia and the Ukraine. Effective emergency warning and response systems are needed on major rivers and harbours in the region.

(b) Improvements in combined municipal and industrial wastewater treatment systems. The main benefit from these investments is in the reduction of organic pollution loads (BOD_5) on the Baltic Sea and the coastal waters. Additional nutrient removal facilities (tertiary treatment) at municipal wastewater treatment plants, however, have only a small impact on the total nutrient load to the Sea, in particular if they are located upstream. In such cases, and unless there are good arguments based on local benefits, investments in nutrient removal treatment systems should be deferred until substantial progress is made in nutrient load reduction in the agriculture sector and other, higher priority pollution reduction measures are completed. In this context a high priority has been assigned to the following types of projects included in Table 3:

- Complete unfinished and inoperable treatment facilities;
- Install or improve industrial pre-treatment;
- Eliminate uncontrolled discharge of wastewaters into the environment;
- Expand and improve safe disposal of sludges.

(c) Rational industrial pollution control. Wherever possible and both physically and economically sensible, industrial pollution problems should be considered separately from municipal systems. Pollution control measures should be specific to each industrial process so that pollution can be dealt with at the source. Rather than treating existing problems at the end-of-pipe or stack, each sector should be assessed to identify economically competitive and viable enterprises. Environmental audits should be conducted and an integrated strategy of environmental and process modernization developed for each plant.

(d) Control of pollution loads from the agriculture sector. The Programme will support the incorporation of environmentally oriented incentives into agriculture sector reform and development programmes, and the implementation and monitoring of pilot and demonstration projects to develop low-cost environmental control technology and practices. Significant impact on reduction of nutrient loads on the Baltic Sea and hence on the damaging effects of eutrophication can be achieved by introducing better manure handling and fertilizer application and storage practices. The widespread dissemination and adoption of these practices should be a high priority policy objective in the agriculture sector.

44 **Impact of the Phase I Investment Programme.** Implementation of projects to address the 29 priority municipal and industrial "hot spots" for which adequate data is available, is projected to annually reduce BOD_5 by 300 000 tons, nitrogen by 33 500 tons, and phosphorus by 8 200 tons. This would include an estimated annual reduction, from 19 "priority hot spots" in the Vistula and Oder/Odra River Basins amounting to 160 000 tons of BOD_5, 23 500 tons of nitrogen and 6 500 tons of phosphorus. The annual load reduction from 10 "priority hot spots" in Russia, Estonia, Latvia, and Lithuania totals an additional 140 000 tons of BOD_5, 10 000 tons of nitrogen and 1 700 tons of phosphorus. While the Programme will support a variety of interventions to reduce agricultural runoff, it has not been possible to accurately calculate the total load reductions. Major reductions in AOX have been achieved since 1987 in the pulp and paper industry in the Nordic countries. These reductions are expected to continue thanks to the introduction of process changes and of chlorine free pulp technology. Since both total and individual discharges of these pollutants are uncertain at present, estimates of load reduction cannot be made at this time. More reliable data will be available in the near future, with completion of the second HELCOM sponsored pollution load compilation.

45 **Complementary Actions.** The policy reform agenda follows logically from the Phase I investment programme:

- Rationalize and harmonize standards;
- Establish incentives for environmental investment;
- Implement the polluter/user-pays principles;
- Establish viable mechanisms for the levy, collection, and retention of revenues to finance environmental projects particularly at the local level.

46 As noted earlier, capacity building will be a principal focus of efforts during Phase I of Programme implementation in order to take advantage of the time needed for the transforming economies to generate project financing resources. The capacity building agenda will thus focus on three areas:

- Local capacity to finance and manage projects;
- Environmental monitoring and regulatory systems;
- Project preparation including environmental assessment.

47 **Cost of the Phase I Programme.** The target level of investment for Phase I of the Programme is 5 billion ECU. It is anticipated that national governments, international financial institutions, bilateral organizations and private sector interests will develop projects for implementation during Phase I based on Programme "priority hot spots" indicated in Table 3.

48 Activities for Phase I were selected by the Task Force following pre-feasibility studies by independent consultants, under the supervision of the international financial institutions, analysis of available data and field visits, consultations with representatives of national and local governments, and input from a series of public hearings in the study areas. The criteria used in the selection of "hot spots" in Denmark, Finland and Sweden was based on evaluation of potential priorities, using the status of activities or the load from these hot spots on the Baltic Sea in 1990 as a baseline. Site in Germany were selected on the basis of a pre-feasibility study supervised by the Federal Government and in consultation with representatives of the concerned Länder. As mentioned previously, selection of activities for Phase I is determined by potential impact on the water quality and ecological systems of the Baltic Sea, its coastal waters, and its catchment area, and by present institutional capacity, particularly for project preparation and financing in the eastern and southern portions of the region. In addition, the present limitations on public sector financial resources for environmental project investment, which strongly influence the size and sequencing of Programme actions, are expected to improve only slowly for several years. The target level of investment for Phase I reflects these concerns.

49 **Establishment of a Programme Implementation Mechanism**. According to the Baltic Sea Declaration, the key elements of the Programme should be under implementation by 1993. Even though the main responsibility for implementing the Programme will have to be borne by the governments concerned, co-ordination of many Programme activities is needed. Several existing activities of HELCOM, including monitoring of the open sea and coastal waters, as well as land-based pollution, both waterborne and airborne, may contribute directly to future activities under the Programme. However, further feed-back mechanisms may have to be developed. There are a number of new activities to be carried out which are not within the current terms of reference of HELCOM. These new activities include expanded monitoring of pollution and the impact of Programme actions, maintenance of an up-to-date and more comprehensive data base, co-ordination of policy and regulatory reforms, of technical assistance, and of research programmes and information exchange, as well as periodic updating of the Programme.

50 **Funding of Feasibility Studies for Priority Projects.** The funding of feasibility studies for "priority hot spots" is critical to the rapid implementation of the Programme. Without good feasibility studies the various financial contributors, will not have adequate information to decide on whether to support a particular project. The expressed desire of the Contracting Parties to minimize delays in implementing the Programme makes it imperative that commitments to fund and carry out feasibility studies be made as soon as possible. It is estimated that the initial sum required for the preparation of feasibility studies, including detailed environmental audits of industrial facilities, will be approximately 30 million ECU. The launching of the feasibility studies for specific investments would be subject to decision on a case-by-case basis, after identification of a project sponsor with the necessary implementation and fund-raising capabilities, and an expressed willingness to undertake the project. The Nordic countries, Germany and the Commission of European Communities might wish to consider providing funding for these studies. A part of this financing could

be made available as special funds to the four multilateral financial institutions to ensure continuity in the work.

51 **Mobilization of Financial Resources for Investment Activities.** The mobilization of local, national, bilateral and multilateral financial resources to meet capital and recurrent costs for all aspects of the Programme will be critical for its successful implementation. The cooperating multilateral financial institutions could support the mobilization of resources in the context of their lending programmes on both a sectoral and project-specific basis. Measures need to be taken to increase the capacity and the willingness of government, industry and the public to support the use of taxes and increased user charges to cover the costs of key environmental improvements. Recognizing the serious constraints presently encountered by the countries in the eastern and southern portions of the region, the potential levels of grant funding and allocations under lending programmes should be reviewed.

52 To this end, and in order to provide for the broadest possible financial support, it is proposed to organize an international conference on mobilizing financing for implementing the Baltic Sea Joint Comprehensive Environmental Action Programme. Preparations for the conference should begin as soon as possible with the aim of holding the conference in late 1992 or early 1993. The co-operating international financial institutions will assist in organizing the conference with the aim of mobilizing local, national, bilateral, and international financial resources for implementation of the Programme. To be successful, the conference will have to be carefully prepared. In addition to the bilateral and multilateral financing institutions represented on the Task Force, invitations might be extended to selected members of the G-24 group, as well as to private, semi-public, and public merchant banks specialized in privatization and in financing environmental improvements, export credit agencies, and risk capital financiers that could invest in domestic enterprises to manufacture the equipment and supply the services necessary for the Programme.

List of Figures and Tables

BALTIC SEA - JOINT COMPREHENSIVE REPORT

Environmental Action Programme

TABLE 1 -- SUMMARY OF ESTIMATED COSTS BY PROGRAMME ELEMENT

	Element	Phase I Millions ECU (1993 - 1997)	Phase II Millions ECU (1998 - 2012)	Total Millions ECU (1993 - 2012)
1	Policies, Laws and Regulations	5	5	10
2	Institutional Strengthening and Human Resource Development	70	140	210
3	Investment Activities			
A	Point Source Pollution			
i	Immediate Support and Warning Systems	50		50
ii	Municipal Wastewater Treatment	1,000	2,000	3,000
iii	Combined Municipal and Industrial Wastewater Treatment	1,600	4,000	5,600
iv	Pulp and Paper Industry Environmental Control	400	1,000	1,400
v	Environmental Control at Other Industries	300	1,000	1,300
vi	Solid and Hazardous Waste Mangement	200	800	1,000
vii	Air Quality Management	460	1,200	1,660
B	Non-Point Source Pollution	800	2,700	3,500
4	Management Programmes for Coastal Lagoons and Wetlands	100	120	220
5	Applied Research	10	20	30
6	Public Awareness and Environmental Education	5	15	20
	TOTAL	5,000	13,000	18,000

BALTIC SEA - JOINT COMPREHENSIVE REPORT

Environmental Action Programme

TABLE 2 -- SUMMARY OF ESTIMATED INVESTMENT COSTS FOR HOT SPOTS BY COUNTRY

	COUNTRY	COSTS Million ECU Preliminary Cost Estimates	
1	Sweden	451.0	
2	Finland	424.7	
3	Russia (St. Petersburg Region)	1,077.8	
4	Estonia	1,555.0	
5	Latvia	427.3	
6	Lithuania	512.0	
7	Russia (Kaliningrad Region)	319.2	
8	Belarus	31.0	(Incomplete)
9	Poland	4,043.0	
10	Ukraine	214.0	
11	Czech and Slovak Federal Republic	113.6	
12	Germany	360.0	
13	Denmark	312.5	
14	Norway	0.0	
	Estimated Total	9,841.1	

BALTIC SEA - JOINT COMPREHENSIVE REPORT

Environmental Action Programme

TABLE 3 -- SUMMARY OF PRELIMINARY COSTS AT HOT SPOTS BY STUDY AREA

Priority Hot Spots	LOCATION	Country	NAME Site	TYPE	TOTAL COST Million ECU	INVESTMENT COST For. Million ECU	INVESTMENT COST Local Million ECU	OPERATING COST Million ECU/YEAR
	BOTHNIAN BAY							
	Bothnian Bay	Sweden	Rönnskärsverken	Industry (Metal Smelter)	45.0		45.0	tbd
	Bothnian Bay	Finland	Metsä - Botnia Oy Kemi	Industry (Pulp & Paper)	18.0		18.0	tbd
	BOTHNIAN SEA							
	Bothnian Sea	Sweden	Husum Kraft Mill (1)	Industry (Pulp & Paper)	12.0		12.0	4.0
	Bothnian Sea	Sweden	Östrand (1)	Industry (Pulp & Paper)	0.0		0.0	2.0
	Bothnian Sea	Sweden	Vallvik (1)	Industry (Pulp & Paper)	0.0		0.0	1.0
	Dalälven River	Sweden	Dalälven	Mining Waste	15.0		15.0	0.0
	Bothnian Sea	Finland	Outokumpu Group Harjavalta	Industry (Metal Smelter)	12.7		12.7	0.7
	Bothnian Sea	Finland	Kemira Oy Vuorikemia	Industry (Titanium oxide)	tbd		tbd	tbd
	ARCHIPELAGO AND ÅLAND SEAS							
	Arch & Åland Seas	Finland	Fish Farming	Fish Farming	na		na	na
	Archipelago Sea	Finland	Agriculture (2)	Agricultural Runoff	55.0		55.0	na
	NEVA RIVER BASIN / LAKE LADOGA							
	Lake Saimaa	Finland	YPT Jouteeno	Industry (Pulp & Paper)	45.0		45.0	tbd
	Lake Saimaa	Finland	Kaukas Lappeenranta	Industry (Pulp & Paper)	28.0		28.0	1.9
	Lake Saimaa	Finland	E-G Kaukopää	Industry (Pulp & Paper)	46.0		46.0	4.0
	Lake Ladoga	Russia	Syasstroi	Industry (Pulp & Paper)	34.0	17.5	16.5	tbd
	Lake Ladoga	Russia	Volkhov	Industry (Aluminum)	2.8	2.1	0.8	tbd
	GULF OF FINLAND							
	Gulf of Finland	Finland	Sunila Oy - Kotka	Industry (Pulp & Paper)	30.0		30.0	
	Gulf of Finland	Finland	Helsinki Region	Municipal	190.0		190.0	5,5
X	Gulf of Finland	Russia	St. Petersburg	Connection Sewers	149.0	32.2	116.8	tbd
X	Gulf of Finland	Russia	St. Petersburg (Urban) (3)	Municipal & Industrial	250.0	175.0	75.0	tbd
X	Gulf of Finland	Russia	St. Petersburg (Suburban)	Municipal & Industrial	159.0	33.9	125.1	tbd
	Gulf of Finland	Russia	St. Petersburg	Phosphorous Removal	38.0	12.4	25.6	tbd

BALTIC SEA - JOINT COMPREHENSIVE REPORT

Environmental Action Programme

TABLE 3 -- SUMMARY OF PRELIMINARY COSTS AT HOT SPOTS BY STUDY AREA

Priority Hot Spots	LOCATION	Country	NAME Site	TYPE	TOTAL COST Million ECU	INVESTMENT COST For. Million ECU	INVESTMENT COST Local Million ECU	OPERATING COST Million ECU/YEAR
	Gulf of Finland	Russia	St. Petersburg	Industry (Metal Plating)	203.3	43.1	160.2	tbd
	Gulf of Finland	Russia	St. Petersburg	Hazardous Waste	148.4	70.5	77.9	tbd
X	Gulf of Finland	Russia	St. Petersburg Region	Large Livestock Farms	93.3	37.0	56.3	tbd
X	Gulf of Finland	Estonia	Narva	Power Plants (Oil Shale)	1,071.4	232.1	839.3	tbd
	Gulf of Finland	Estonia	Kohtla Järve	Area Municipal & Industrial	120.4	54.5	65.9	tbd
	Gulf of Finland	Estonia	Kehra	Industry (Pulp & Paper)	5.9	3.2	2.7	tbd
X	Gulf of Finland	Estonia	Tallinn	Municipal & Industrial	93.6	17.8	75.8	tbd
	Gulf of Finland	Estonia	Tallinn	Industry (Pulp & Paper)	2.9	1.8	1.1	tbd
	Gulf of Finland	Estonia	Gulf of Finland	Agricultural Runoff Programme	65.0	5.0	60.0	tbd
	WESTERN ESTONIAN COAST							
	Estonian Coast	Estonia	Haapsalu	Municipal & Industrial	25.0	13.0	12.0	1.0
X	Estonian Coast	Estonia	Matsalu Bay	Management Programme	30.0	5.0	25.0	0.1
	GULF OF RIGA/DAUGAVA RIVER BASIN							
X	Gulf of Riga	Estonia	Pärnu	Municipal & Industrial	18.0	14.0	4.0	2.1
	Gulf of Riga	Estonia	Paide	Municipal & Industrial	4.1	1.5	2.6	1.0
	Gulf of Riga	Estonia	Vohma Meat Combine	Industry	3.7	1.4	2.3	0.2
	Gulf of Riga	Estonia	Gulf of Riga	Agricultural Runoff Programme	105.0	11.0	94.0	tbd
X	Gulf of Riga	Estonia/Latvia	Gulf of Riga Mgt	Management Programme	20.0	5.0	15.0	tbd
X	Gulf of Riga	Latvia	Sloka	Industry (Pulp & Paper)	72.0	72.0	0.0	tbd
X	Gulf of Riga	Latvia	Latbiofarm	Industry (Pharmaceutical)	19.0	19.0	0.0	tbd
X	Gulf of Riga	Latvia	Agriculture / Livestock	Agricultural Runoff Programme	200.0	20.0	180.0	tbd
X	Gulf of Riga	Lithuania	Siauliai	Municipal & Industrial	25.0	10.0	15.0	1.5
	Daugava RB	Latvia	Riga (WWTP Phase II)	Municipal & Industrial	62.5	50.0	12.5	tbd
	Daugava RB	Latvia	VEF Plant (Riga)	Industry (Metals)	tbd	tbd	tbd	tbd
	Daugava RB	Latvia	RER Plant (Riga)	Industry (Metals)	tbd	tbd	tbd	tbd
	Daugava RB	Latvia	Riga	Industry (Various)	tbd	tbd	tbd	tbd
X	Daugava RB	Latvia	Daugavpils	Municipal & Industrial	38.8	31.0	7.8	tbd
	Daugava RB	Belarus	to be determined	to be determined	tbd	tbd	tbd	tbd
	LATVIAN COAST							
X	Latvian Coast	Latvia	Liepaja (3)	Municipal & Industrial	25.0	15.0	10.0	tbd

BALTIC SEA - JOINT COMPREHENSIVE REPORT

Environmental Action Programme

TABLE 3 -- SUMMARY OF PRELIMINARY COSTS AT HOT SPOTS BY STUDY AREA

Priority Hot Spots	LOCATION	Country	NAME Site	TYPE	TOTAL COST Million ECU	INVESTMENT COST For. Million ECU	INVESTMENT COST Local Million ECU	OPERATING COST Million ECU/YEAR
	NEMUNAS RIVER BASIN							
X	Nemunas RB	Russia	Sovetsk	Industry (Pulp & Paper)	3.5	2.5	1.0	0.4
X	Nemunas RB	Russia	Neman	Industry (Pulp & Paper)	4.7	3.2	1.5	0.5
X	Nemunas RB	Lithuania	Kaunas	Municipal & Industrial	85.0	35.0	50.0	5.0
	Nemunas RB	Lithuania	Amalg Azotaz	Industry (Fertilizer)	35.0	35.0	0.0	tbd
	Nemunas RB	Lithuania	Kedainiai	Municipal & Industrial	6.0	2.4	3.6	1.0
	Nemunas RB	Lithuania	Kedainiai	Industry (Chemicals)	tbd	tbd	tbd	tbd
	Nemunas RB	Lithuania	Panevezys	Municipal & Industrial	6.0	2.4	3.6	4.0
	Nemunas RB	Lithuania	Panevezys	Industry (Food)				
	Nemunas RB	Lithuania	Marijampole	Municipal & Industrial	25.0	10.0	15.0	1.5
	Nemunas RB	Lithuania	Alytus	Municipal & Industrial	13.0	5.0	8.0	2.0
X	Nemunas RB	Lithuania	Vilnius / Grigiskes	Municipal & Industrial	45.0	21.0	24.0	6.0
X	Nemunas RB	Lithuania	Agriculture / Livestock	Agricultural Runoff Programme	200.0	20.0	180.0	tbd
	Nemunas RB	Belarus	Grodno	Municipal & Industrial	tbd	tbd	tbd	tbd
	LITHUANIAN COAST							
	Lith. Coast	Lithuania	Mazeikiai	Oil Refinery / Marine.Terminal	tbd	tbd	tbd	tbd
X	Lith. Coast	Lithuania	Klaipeda	Municipal & Industrial	27.0	11.0	16.0	2.5
	Lith. Coast	Lithuania	Cardboard Factory	Industry (Peper)	30.0	19.0	11.0	0.8
	Lith. Coast	Lithuania	Palanga	Municipal	tbd	tbd	tbd	tbd
	LITHUANIAN/KALININGRAD COAST							
X	Lith/Kal Coast	Lith/Russia	Kursiu Lagoon	Management Programme	30.0	10.0	20.0	tbd
	KALININGRAD							
X	Kaliningrad	Russia	Kaliningrad	Municipal & Industrial	50.0	20.0	30.0	4.0
	Kaliningrad	Russia	Pulp & Paper No 1	Industry (Pulp & Paper)	1.5	1.0	0.5	tbd
	Kaliningrad	Russia	Pulp & Paper No 2 (4)	Industry (Pulp & Paper)	182.0	152.0	30.0	tbd
	Kaliningrad	Russia	Kaliningrad	Hazardous Waste	12.5	5.0	7.5	4.0
	Kaliningrad	Russia	Oil Bunkering Station	Industry	tbd	tbd	tbd	tbd
	Kaliningrad	Russia	Agriculture / Livestock	Agricultural Runoff Programme	40.0	5.0	35.0	tbd

BALTIC SEA - JOINT COMPREHENSIVE REPORT

Environmental Action Programme

TABLE 3 -- SUMMARY OF PRELIMINARY COSTS AT HOT SPOTS BY STUDY AREA

Priority Hot Spots	LOCATION	Country	NAME Site	TYPE	TOTAL COST Million ECU	INVESTMENT COST For. Million ECU	INVESTMENT COST Local Million ECU	OPERATING COST Million ECU/YEAR
	KALININGRAD/POLISH COAST							
X	Kal/Pol Coast	Russia/Poland	Vistula Lagoon	Management Programme	20.0	5.0	15.0	tbd
	VISTULA RIVER BASIN/BALTIC COAST OF POLAND (5)							
X	Baltic Coast	Poland	Kozalin	Municipal & Industrial	44.2	12.2	32.0	2.5
X	Baltic Coast	Poland	Gdynia - Debogorze	Municipal & Industrial	21.0	17.0	4.0	4.1
X	Baltic Coast	Poland	Gdansk - Wschod	Municipal & Industrial	129.0	41.0	88.0	7.3
	Vistula	Poland	Swiecie	Industry (Pulp & Paper)	13.0	5.7	7.3	1.0
X	Vistula	Poland	Bydgoszcz - Fordon	Municipal & Industrial	42.7	14.6	28.1	2.1
	Vistula	Poland	Bydgoszcz - Kapusciska	Industry (Chemical)	75.0	22.0	53.0	3.5
X	Vistula	Poland	Torun	Municipal & Industrial	95.0	27.7	67.3	7.3
X	Vistula	Poland	Wloclawek	Municipal & Industrial	31.5	11.4	20.1	1.5
	Vistula	Poland	Warsaw - Czajka	Municipal & Industrial	76.0	21.0	55.0	4.7
X	Vistula	Poland	Warsaw - Siekierki	Municipal & Industrial	119.0	36.0	83.0	5.6
	Vistula	Poland	Warsaw - Pancerz	Municipal & Industrial	232.0	75.0	157.0	11.6
	Vistula	Poland	Lublin - Hajdow	Municipal & Industrial	18.0	7.0	11.0	5.2
X	Vistula	Poland	Krakow - Plaszow	Municipal & Industrial	95.0	32.0	63.0	7.6
X	Vistula	Poland	Krakow - Kujawy	Municipal & Industrial	100.0	31.0	69.0	5.4
X	Vistula	Poland	Katowice -East (6)	Municipal & Industrial	153.0	50.0	103.0	23.0
	Vistula	Poland	Jaworzno Organico Azot	Industry (Chemical)	1.7	0.6	1.1	0.1
	Vistula	Poland	Zgierz - Boruta Dyestuffs	Industry (Chemical)	3.5	1.4	2.1	0.3
	Vistula	Poland	Oswiecim - ZCHO Chem.	Industry (Chemical)	16.5	6.6	9.9	tbd
	Vistula	Poland	Zaklady Gorniczo	Industry (Metals)	7.0	2.8	4.2	1.0
	Vistula	Belarus	Brest	Municipal & Industrial	31.0	11.0	20.0	4.2
X	Vistula	Ukraine	Lvov	Municipal & Industrial	214.0	81.0	133.0	6.5
X	Vistula	Poland	Agriculture / Livestock	Agricultural Runoff Programme	1,300.0	1,150.0	150.0	tbd
	Vistula	Poland	Upper Basin (7)	Salt Control	tbd	tbd	tbd	tbd
	ODER / ODRA RIVER BASIN (5)							
X	Oder / Odra	Poland	Szczecin	Municipal & Industrial	83.6	16.7	66.9	6.7
X	Oder / Odra	Poland	Szczecin	Industry (Fert,Food,P&P)	13.6	2.7	10.9	1.0
	Oder / Odra	Poland	Poznan	Municipal & Industrial	128.8	25.8	103.0	10.3
X	Oder / Odra	Poland	Lodz	Municipal & Industrial	202.9	40.6	162.3	16.2

BALTIC SEA - JOINT COMPREHENSIVE REPORT

Environmental Action Programme

TABLE 3 -- SUMMARY OF PRELIMINARY COSTS AT HOT SPOTS BY STUDY AREA

Priority Hot Spots	LOCATION	Country	NAME Site	TYPE	TOTAL COST Million ECU	INVESTMENT COST For. Million ECU	INVESTMENT COST Local Million ECU	OPERATING COST Million ECU/YEAR
	Oder / Odra	Poland	Zielona Gora	Municipal & Industrial	38.8	7.8	31.0	3.1
X	Oder / Odra	Poland	Legnica-Glogow	Industry (N-Fer,Cu,Food)	108.0	44.0	64.0	tbd
	Oder / Odra	Poland	Wroclaw	Municipal & Industrial	149.7	29.9	119.8	12.0
	Oder / Odra	Poland	Wroclaw	Industry (Chem,Food,Textiles)	19.6	3.9	15.7	1.4
	Oder / Odra	Poland	Ubocz - Luban	Industry (Fertilizer)	0.8	0.2	0.6	0.1
	Oder / Odra	Poland	Boleslawiec	Industry (Fertilizer)	0.8	0.2	0.6	0.1
X	Oder / Odra	Poland	Katowice-West	Municipal & Industrial	194.5	38.9	155.6	15.6
X	Oder / Odra	Poland	Katowice-West	Industry (Coke,Sid,Fert)	8.8	1.8	7.0	0.6
X	Oder / Odra	CSFR	Ostrava	Municipal & Industrial	78.6	15.7	62.9	6.3
X	Oder / Odra	CSFR	Ostrava Area	Industry (Chem,P&P, etc.)	35.0	7.0	28.0	2.5
	Oder / Odra	CSFR/Poland	Upper Basin (7)	Salt Control	tbd	tbd	tbd	tbd
X	Oder / Odra	Poland	Agriculture / Livestock	Agricultural Runoff Programme	500.0	50.0	450.0	tbd
X	Oder / Odra	Poland/Germany	Odra Lagoon mgt	Management Programme	20.0	5.0	15.0	tbd
	ARKONA BASIN							
	Arkona Basin	Germany	Greifswald	Municipal & Industrial	45.0		45.0	tbd
	Arkona Basin	Germany	Neubrandenburg	Municipal & Industrial	40.0		40.0	tbd
	Arkona Basin	Germany	Stralsund	Municipal & Industrial	30.0		30.0	tbd
	Arkona Basin	Germany	Stavenhagen - Malchin	Municipal & Industrial	25.0		25.0	tbd
	Arkona Basin	Germany	Agriculture	Agricultural Runoff Programme	tbd		tbd	tbd
	BELT SEA							
	Belt Sea	Germany	Lübeck	Municipal & Industrial	60.0		60.0	tbd
	Belt Sea	Germany	Wismar	Municipal & Industrial	50.0		50.0	tbd
	Belt Sea	Germany	Rostock	Municipal & Industrial	100.0		100.0	tbd
	Belt Sea	Denmark	Agriculture (8)	Agricultural Runoff Programme	40.0		40.0	tbd
	THE SOUND							
	The Sound	Denmark	Copenhagen	Municipal	212.5		212.5	16,3
	The Sound	Denmark	Agriculture (8)	Agricultural Runoff Programme	20.0		20.0	tbd
	The Sound	Sweden	Agriculture	Agricultural Runoff Programme	10.0		10.0	12.0

BALTIC SEA - JOINT COMPREHENSIVE REPORT

Environmental Action Programme

TABLE 3 -- SUMMARY OF PRELIMINARY COSTS AT HOT SPOTS BY STUDY AREA

Priority Hot Spots	LOCATION	Country	NAME Site	TYPE	TOTAL COST Million ECU	INVESTMENT COST For. Million ECU	INVESTMENT COST Local Million ECU	OPERATING COST Million ECU/YEAR
	KATTEGAT							
	Göta Älv River	Sweden	Skoghall	Industry (Pulp & Paper)	40.0		40.0	tbd
	Kattegat	Sweden	Göteborg	Municipal	50.0		50.0	tbd
	Kattegat	Sweden	Agriculture	Agricultural Runoff Programme	10.0		10.0	9.0
	Kattegat	Denmark	Agriculture (8)	Agricultural Runoff Programme	40.0		40.0	tbd
	SWEDISH COAST							
	Swedish Coast	Sweden	Stockholm	Municipal	250.0		250.0	tbd
	BORNHOLM BASIN							
	Bornholm Basin	Sweden	Nymölla	Industry (Pulp & Paper)	14.0		14.0	tbd
	Bornholm Basin	Sweden	Agriculture	Agricultural Runoff Programme	5.0		5.0	5.0

Notes

Figures in the table should be considered as preliminary estimates.

TBD = To be determined.

NA = Not available

(1) *Figures provided by Sweden include expenditures made after 1990.*

(2) *Figures provided for agricultural runoff programmes should be considered as preliminary and subject to modification in the future.*

(3) *Cost estimates are based on professional judgement and require further evaluation.*

(4) *Facility is proposed for complete reconstruction.*

(5) *Air quality management programmes for Poland and the CSFR are not included in the table as they are being adressed by other complementary investment programmmes.*

(6) *Cost estimate does not include industrial pre-treatment costs which would be significant.*

(7) *Figures for salt control programmes will be added upon completion of studies of control alternatives presently being conducted with funding from CEC/Phare and World Bank.*

Some proposals would require up to 1.0 billion ECU in investment costs.

(8) *The estimated total cost for the control of agricultural runoff in Denmark for both the Baltic Sea and North Sea catchment areas is 100 million ECU.*

The figures provided will require adjustment .

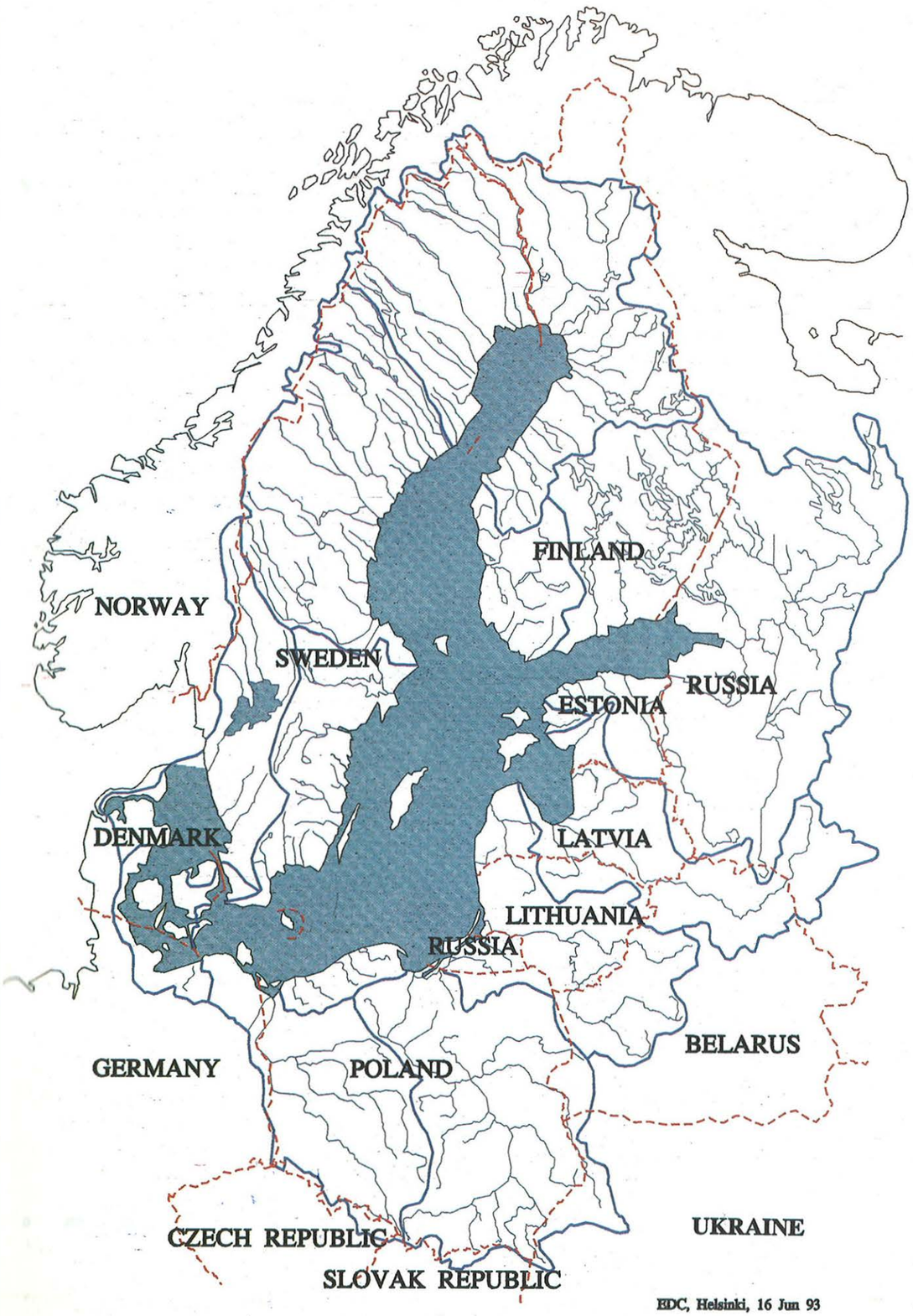


Figure 1 The Baltic Sea Catchment Area

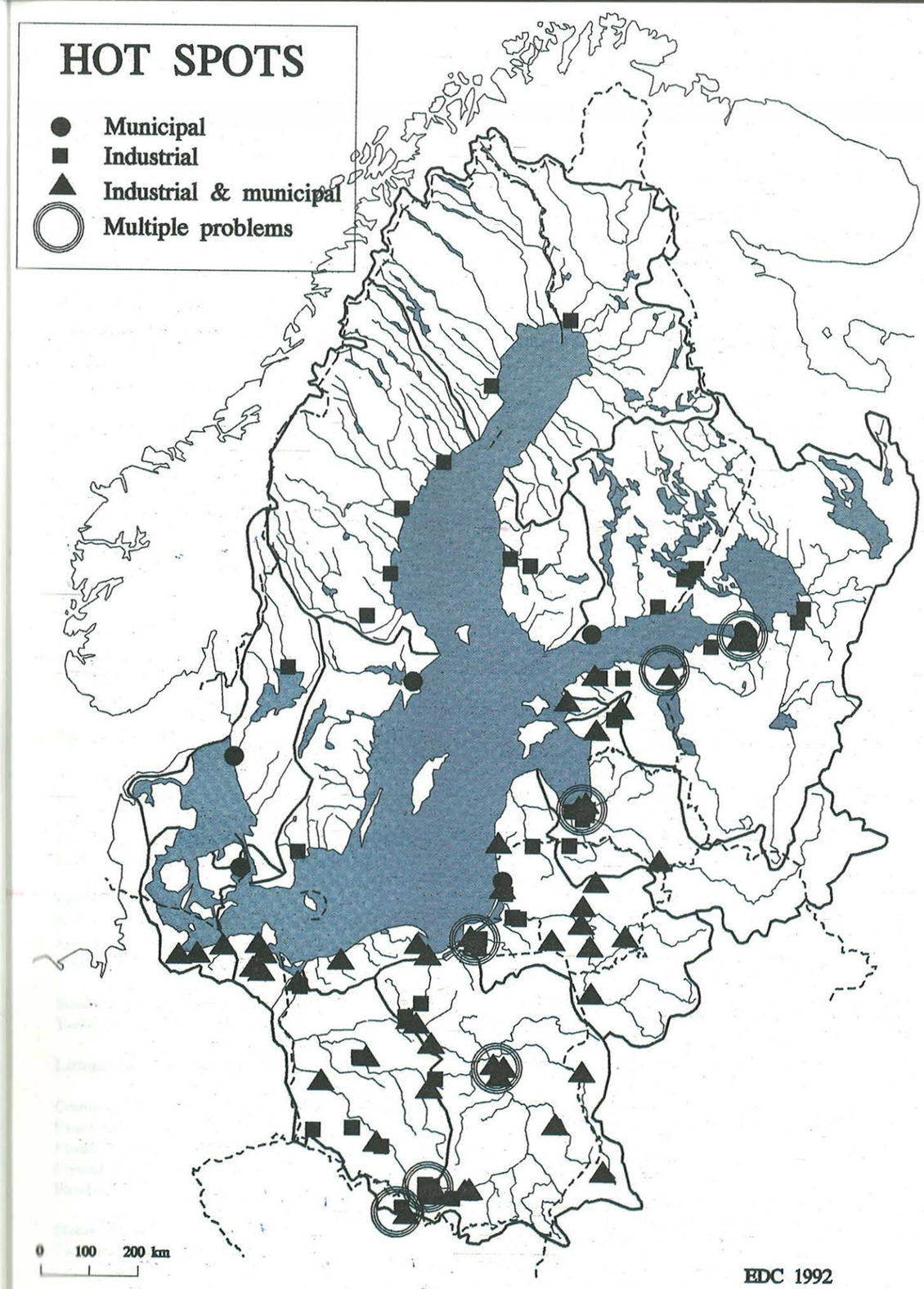


Figure 2 Map of the Point Source Pollution "Hot Spots"

B. THE PRE-FEASIBILITY STUDIES

St. Petersburg, St. Petersburg region, Karelia and Estonia

Country: Russia and Estonia
Executing Agency: Nordic Investment Bank (NIB)
Financed: Finland
Consultants: Plancenter Ltd, IVO International, Vesi-Hydro Consulting Ltd, Enviro Data Ltd, Outokumpu EcoEnergy Ltd

Status: Synthesis Report, September 1991

Western Coast of Estonia

Country: Estonia
Executing Agencies: Nordic Investment Bank (NIB) and World Bank (WB)
Financed: Finland and Sweden
Consultants: Plancenter Ltd, Swedish Environmental Research Institute (IVL) and Institute of Ecology and Marine Research (Estonia)

Status: Synthesis Report, August 1992
Technical Report, August 1992
Supplemental Environmental studies in Estonia, August 1992

The Gulf of Riga and the Daugava River Basin

Country: Latvia
Executing Agency: Nordic Investment Bank (NIB)
Financed: Denmark and Sweden
Consultants: Carl Bro a/s in cooperation with Latvian Republic Environmental Protection Committee (LREPC), Swedish Development Consulting Partners (SDCP), Swedish Environmental Research Institute (IVL) and Swedish Meteorological and Hydrological Institute (SMHI)

Status: Synthesis Report, June 1992
Technical Report, June 1992

Lithuanian Coast and the Nemunas River Basin

Country: Lithuania (and Russia, Poland, Belarus)
Executing Agency: Nordic Investment Bank (NIB)
Financed: Denmark and Sweden
Consultants: K-Konsult, I. Krüger, ÅF-IPK, Rambøll & Hannemann

Status: Synthesis Report, May 1992
Technical Report, May 1992

Kaliningrad Region and the Pregel River Basin

Country: Russia (and Poland)
Executing Agencies: Nordic Investment Bank (NIB) and European Bank for Reconstruction and Development (EBRD)
Financed: Nordic Project Fund (NOPEF) and Norwegian Trust Fund at the EBRD
Consultants: Norconsult in joint venture with Jaakko Pöyry

Status: Synthesis Report, April 1992
Technical Report, April 1992

Vistula River Basin and Baltic Coast of Poland

Country: Poland
Executing Agency: World Bank
Financed: Denmark and Sweden
Consultants: Sweco, Cowiconsult, VKI, Hydroprojekt, Stolica

Status: Part I, Synthesis Report, November 1992
Technical Reports (PartIIA and IIB), November 1992

Oder/Odra River Basin

Countries: Czech and Slovak Federal Republic, Germany and Poland
Executing Agency: European Investment Bank (EIB)
Financed: Commission of European Communities (CEC)
Consultant: BCEOM

Status: Synthesis Report, April 1992
Executive Summary & Summary of contents in Polish, Czech, Slovak and German, April 1992
Technical Report 1, Point Pollution Sources - Industries, April 1992
Technical Report 2, Point Pollution Sources - Municipalities, April 1992
Technical Report 3, Non Point Pollution Sources, April 1992
Technical Report 4, Institutional and Environmental Impact Assessment, April 1992

North German Baltic coast

Country: Germany
Executing Agency: Federal Environmental Agency
Financed: Germany
Consultant: Lahmeyer International GmbH, Frankfurt a.M., Germany

Status: Final Report, February 1993

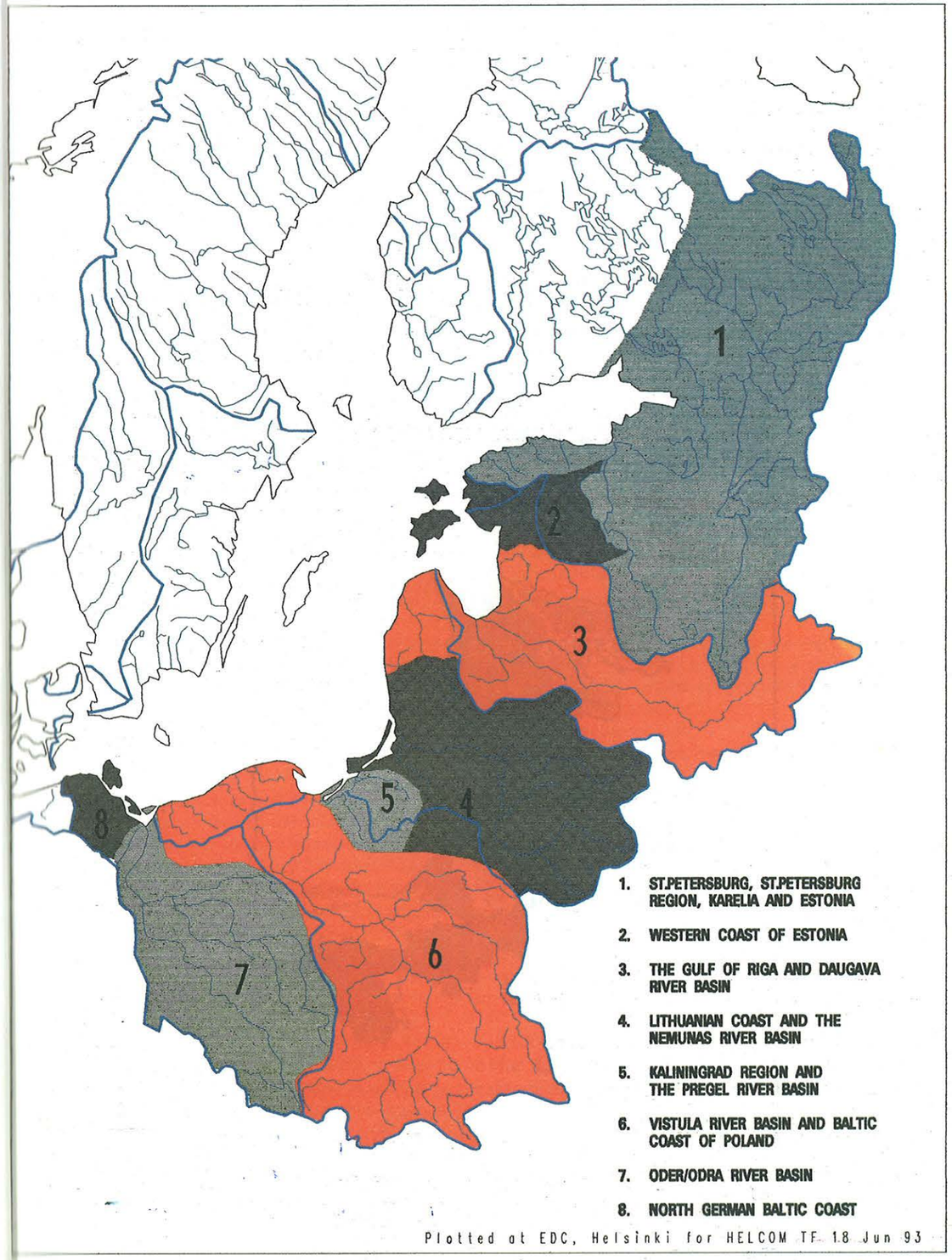


Figure 3 Areas of the pre-feasibility studies established by the HELCOM ad hoc high level Task Force

Ministry of the Environment of Finland

Environmental priority action programme for Leningrad, Leningrad Region, Karelia and Estonia

SYNTHESIS REPORT

Plancenter LTD

September 1991

IVO International | Vesi-Hydro Consulting Ltd | Enviro Data Ltd | Outokumpu EcoEnergy Ltd

4 432491U

ENVIRONMENTAL PRIORITY ACTION PROGRAMME FOR LENINGRAD, LENINGRAD REGION, KARELIA AND ESTONIA

EXECUTIVE SUMMARY

The Finnish Government has drawn up a plan of action concerning co-operation in the near future with Eastern European countries. Co-operation in the field of environmental protection occupies a central position in the plan. In connection with the plan, an Environmental Review and Priority Action Programme for Leningrad, Leningrad region, Karelia and Estonia has been made to determine the main environmental problems and the main measures to reduce them.

A consortium of five Finnish consulting companies was chosen to carry out the task. The work itself was done in close co-operation with the authorities and establishments in target areas, the Finnish Ministry of the Environment and the Finnish consultant group. The co-operation between different parties began with seminars held in Leningrad, Karelia and Estonia in February 1991. The selection of the most urgent environmental projects was done in the negotiations held in Leningrad, Petrozavodsk and Tallinn in mid-March, 1991. The results of the work were presented to the target area authorities in a seminar held in Espoo in the end of May.

The work was done in two stages. The first stage began in January and ended in mid-March. As a result of the first stage, sixteen top priority projects for the environmental action programme were chosen. In the second stage two combined acquaintance and negotiation trips were made to these targets. The pre-feasibility studies have been based on the information obtained in these trips. A synthesis report was prepared based on the information gathered from these studies and information compiled from other sources. In addition to the evaluation of the present situation, a comprehensive programme for the improvement of the environmental situation is presented.

The environmental priority action programme will be a part of the work to carry out the joint comprehensive programme for the whole Baltic Sea which was agreed to be done in the Baltic Sea Conference of the prime ministers, held in Ronneby, Sweden in September 1990. Similar studies to this priority action programme will be done in all Eastern European countries within the catchment area of the Baltic Sea. After all these studies are completed, the joint comprehensive programme will be prepared and ratified in all the countries within the catchment area of the Baltic Sea.

Present environmental status in the target areas

Air pollution

Big industrial enterprises and power plants are located in the target areas. Their atmospheric emissions are very great. These emissions, combined with traffic emissions have already caused negative health effects in many of the target areas.

The main part of the sulphur dioxide emissions generated in Leningrad and Leningrad region originates from thermal and electric power stations. Most

of the city stations (70 %) have gone over to natural gas, whereas only 17 % of the stations in the region have so far done so. In the next couple of years the use of natural gas will increase also in Leningrad region.

The major atmospheric emission sources in Karelia are the pulp and paper and the mining industry. Almost 40 % of the total sulphur dioxide emissions originate from the Kostamuksha mining combine. Other notable sources of sulphur dioxide emissions are the big pulp and paper mills. The atmospheric emissions of the Nadvoitsy aluminum plant have an effect on the health of local people: up to 90 % of children in Nadvoitsy have been found to suffer from fluorosis.

The greatest sources of atmospheric emissions in Estonia are caused by the two big power plants located nearby Narva town. These plants use oil shale as fuel. The sulphur dioxide emissions of these plants are responsible for about 75 % of the total sulphur dioxide emissions in Estonia.

Due to the areal wind directions the biggest transborder environmental effects are mainly directed towards Finland. In parts of southern Finland the emissions of the Narva power plants are responsible for 10-20 % of the total sulphur deposition. Correspondingly, 20-30 % of the total sulphur deposition in eastern Finland originates from Kostamuksha. Local effects are even greater. Nitrogen emissions from the target areas account for 10-30 % of the total oxidized nitrogen and 20-50 % of the total reduced nitrogen deposition figures in Finland.

Water pollution

The Gulf of Finland is one of the most polluted areas in the Baltic Sea. An estimated amount of 25 % of the total phosphorus point-source load is discharged into the Gulf of Finland, which occupies only about 7 % of the total Baltic Sea area.

The contribution of non-point load to the total load has been estimated to be about 50 %. The city of Leningrad is the biggest point-source loader in the Gulf of Finland. At the moment its waste water load is equivalent to about 40 % of the total BOD_5 point-source load and about 50 % of the total phosphorus point-source load discharged to the Gulf of Finland. The biggest problems related to waste water treatment in Leningrad are insufficient pretreatment of industrial waste waters, straight discharging of about two million people's waste waters into the recipient, and insufficient capacities and nutrient removal rates at the central and suburban waste water treatment plants. The discharge of the untreated waste waters of about two million people is partially due to straight discharge sewers (about 40 %), and partially due to insufficient treatment capacity and bypasses (about 60 %).

The present point-source load of Estonia is equivalent to about 35 % of the total BOD_5 point-source load and about 10 % of the total phosphorus point-source load discharged to the Gulf of Finland. The city of Tallinn is responsible for about a third of these figures. Other notable Estonian water polluters are the industry of Kohtla-Järve and Narva areas.

The waste water load of Karelia is directed to Lake Ladoga and Lake Onega. Lake Ladoga obviously suffers from eutrophication which is due to the phosphorus load that has increased 2.7 times since the beginning of the

1960s. This load clearly exceeds the natural tolerance of the lake. The biggest polluters of Lake Ladoga are the industrial enterprises located at the shoreline and the non-point load of agriculture.

The environmental situation of Lake Onega is still mostly good but some of its bays are obviously suffering from eutrophication. The biggest polluters of Lake Onega are the town of Petrozavodsk and the pulp and paper mill of Kondopoga.

Waste management

The biggest problems of waste management in the target areas are related to the management of municipal and industrial solid wastes, hazardous wastes, waste water sludges and livestock farming wastes.

In Leningrad and Leningrad region all the problems mentioned above are current. Still the biggest problems are related to the management of hazardous and livestock farming wastes. Nowadays the hazardous wastes of the area are collected to a separate land fill site which will be full in a couple of years. No replacement for this depositing site has been found. The biggest problem related to livestock farming wastes is the treatment and disposal of the wastes generated in six great piggeries. The waste is removed from the piggeries by means of water, thus creating a problem related to waste water treatment, sludge dewatering and disposal. The load of the partially treated waste waters is equivalent to a load of untreated waste waters of about 1.5 million people. These waste waters are not all discharged straight to the recipient, but are mainly stored or utilized in field irrigation.

The problems of waste management in Karelia are related to the municipal wastes of the town of Petrozavodsk, solid wastes of the great industrial plants, waste water sludges and hazardous wastes. The management of all these wastes is insufficient. Hazardous wastes are co-disposed with municipal wastes at land fills.

The problems of waste management in Estonia are related to poor and partially illegal land fill sites, hazardous wastes and ash mountains generated by the oil shale industry and power plants. The drainage of these targets has an effect on the Gulf of Finland, too.

Present environmental administration, legislation and environmental programmes

The present environmental administration is going through a period of constant changes in each of the target areas. The overlapping of duties and fields of responsibility of different organizations can be seen as a common feature. This also has an effect on the control of the environment, which is furthermore hampered by old-fashioned control equipment and the lack of transport vehicles.

Environmental legislation regarding Leningrad, Leningrad region and Karelia is mostly drawn up by the Russian federation. Also the all-union environmental laws are valid if the Russian federation has approved them. In Estonia preparation of laws is done independently and the all-union laws are not valid.

Each target area has its own environmental protection programme. In these programmes, insufficient or over-optimistic plans for financing the projects are a common feature. Therefore these projects will not be fulfilled to the extent they have been proposed. The same applies for the environmental norms which in most of the cases are too strict to be economically achievable.

Environmental priority action programme

The sixteen targets chosen for the environmental priority action programme are located in different administrative areas accordingly: eight projects in Leningrad and Leningrad region, four in Karelia and four in Estonia. The division into different fields of environmental protection is the following: two air pollution projects, six water pollution projects, two waste management projects and six industrial projects. The environmental problems of the industrial projects are related as well to air pollution, as to water pollution and waste management.

Air pollution projects

The air pollution targets chosen for the environmental priority action programme are the Narva power plants in Estonia and the Kostamuksha mining combine. To reduce the environmental effects of Narva power plants, equipping the new boilers (twenty-four units) with desulphurization plants and replacement of old boilers (eighteen units) is proposed. The proposed project will reduce the sulphur dioxide emissions altogether by 70-90 % from the present situation. The total cost estimate of the project is about 6,000 MFIM of which the share of local financing is about 4,700 MFIM and the share of foreign currency financing about 1,300 MFIM.

To reduce the environmental effects of Kostamuksha combine, equipping of all three iron pellet boilers with desulphurization plants is proposed. The project proposed will reduce the sulphur dioxide emissions at least by 65 % from the present situation. The total cost estimate of the project is about 220 MFIM of which the share of local financing is about 80 MFIM and the share of foreign currency financing about 140 MFIM.

Water pollution projects

Four of the chosen water pollution projects are located in the city of Leningrad. The other projects are related to the waste water problems of the city of Tallinn and the town of Petrozavodsk. Leningrad waste water projects are: intensifying the pre-treatment of waste waters in the plating industry, connection of the straight discharging sewers to the collectors of the treatment plants, implementation of phosphorus removal in the central waste water treatment plants and construction of suburban waste water treatment plants.

The waste waters of about 300 plating industry plants of Leningrad hamper the functioning of the waste water treatment plants and worsen the quality of the sludge in such a way that it cannot be utilized in agriculture. Also the discharge of toxic substances into the recipient plays a significant role. In this project equipping of 119 factories with pre-treatment units, internal process modifications to reduce the water consumption and concentration of plating industry into two complexes are proposed. The total cost estimate of

the project is about 1,140 MFIM of which the share of local financing is about 900 MFIM and the share of foreign currency financing about 240 MFIM.

At the moment Leningrad city has 478 discharging sewers that discharge waste waters of about one million people untreated into the recipient. In this project about half of these sewers are proposed to be connected to the tunnels leading to the central treatment plants. Implementation of the proposed project reduces the phosphorus load of Leningrad by almost 20 % and BOD_6-load by about 25 % from the present situation. Correspondingly, the total phosphorus and BOD_6 point-source loads discharged to the Gulf of Finland will be reduced by almost 10 % from the present situation. The total cost estimate of the project is about 830 MFIM of which the share of local financing is about 650 MFIM and the share of foreign currency financing about 180 MFIM.

Nutrient removal rates at present central treatment plants are relatively low. Therefore especially the phosphorus load is significant to the Gulf of Finland. Intensifying phosphorus removal by biochemical or biological methods is proposed. The method to be implemented will be chosen according to plant-scale experiments. Implementation of the proposed project along with the increment of the treatment capacities of the central plants as a part of the local environmental programme will reduce the phosphorus load of Leningrad by about 40 % from the present situation. Correspondingly, the total phosphorus point-source load discharged to the Gulf of Finland will be reduced by about 20 % from the present situation. The total cost estimate of the project is about 210 MFIM of which the share of local financing is about 140 MFIM and the share of foreign currency financing about 70 MFIM.

Waste water treatment at the **four suburbs of Leningrad** is insufficient. Construction of two new plants and enlargement of two present plants is proposed. Enlargement of the sewer system is also included in the project. Implementation of the proposed project reduces the phosphorus load of the suburbs by about 60 % from the present situation. The total cost estimate of the project is about 890 MFIM of which the share of local financing is about 700 MFIM and the share of foreign currency financing about 190 MFIM.

At the moment **the city of Tallinn** has a chemical waste water treatment plant that is planned to be extended into a biological plant by the year 1998. Bad condition of the sewer system and pumping stations causes bypasses into the recipient. Construction of waste water treatment plant and renovation of the sewer system and pumping stations is proposed. Implementation of the proposed project reduces the BOD_6-load to the Gulf of Finland by 80 % from the present situation. Correspondingly, the total BOD_5 point-source load discharged to the Gulf of Finland will be reduced by almost 10 % from the present situation. The total cost estimate of the project is about 525 MFIM of which the share of local financing is about 425 MFIM and the share of foreign currency financing about 100 MFIM.

The town of **Petrozavodsk** has a biological waste water treatment plant at the moment, the capacity of which is insufficient for the treatment of all the waste waters. Additional problems are caused by the insufficient treatment of industrial waste waters and low nutrient removal rates at the waste water treatment plant. Increment in capacity and implementation of phosphorus removal at the plant are proposed. Other proposals include actions regarding

sludge treatment and pre-treatment of industrial waste waters. Implementation of the proposed project reduces the BOD_6-load by about 30 % and phosphorus load by about 80 % from the present situation. The total cost estimate of the project is about 95 MFIM of which the share of local financing is about 85 MFIM and the share of foreign currency financing about 10 MFIM.

Waste management projects

For the collection and treatment of **hazardous wastes in Leningrad and Leningrad region** a project for the implementation of waste collection system and construction of pre-storage, physical-chemical treatment, incineration plant and special land fill facilities is proposed. Renovation of the present land fill site in such a manner that no environmental pollution is caused is included in the project proposal. Implementation of the project prevents the discharge of hazardous wastes into the recipient, thus preventing an ecological catastrophe. The total cost estimate of the project is about 830 MFIM of which the share of local financing is about 435 MFIM and the share of foreign currency financing about 395 MFIM.

Problems caused by **livestock farming wastes of Leningrad region** are related to the treatment of the water used in manure removal process, sludge dewatering and disposal. Construction of four waste water treatment plants, implementation of nutrient removal and sludge treatment are proposed. The implementation of the project will reduce the present waste water load by over 90 %. The total cost estimate of the project is about 520 MFIM of which the share of local financing is about 310 MFIM and the share of foreign currency financing is about 210 MFIM.

Industrial projects

The six industrial targets chosen for the environmental action programme are: (1) Svetogorsk pulp and paper mill located right by the Finnish border, (2) Syasstroy pulp and paper mill and Volkhov aluminium factory located by Lake Ladoga, (3) Segezha pulp and paper mill and Nadvoitsy aluminium factory located by Lake Vyg in Karelia, (4) Pitkyaranta pulp and paper mill located by Lake Ladoga, (5) Tallinn and Kehra pulp and paper mills located close to the city of Tallinn and (6) the Kohtla-Järve industrial plants located by the Gulf of Finland.

The environmental problems of **Svetogorsk pulp and paper mill** are mostly related to atmospheric emissions which, due to the close location to the Finnish border, have also influence on the air quality in Finland. The sulphur dioxide emissions are proposed to be reduced by mainly process technology measures but also external measures are included. In addition the plant will convert from oil to natural gas. Implementation of the project reduces sulphur dioxide emissions by 60-75 % from the present situation. The total cost estimate of the project is about 440 MFIM of which the share of local financing is about 90 MFIM and the share of foreign currency financing about 350 MFIM.

The environmental problems of **Syasstroy pulp and paper mill** are mostly related to both atmospheric and waste water emissions. These problems are proposed to be reduced mainly by process technology measures and by intensified waste water treatment. Implementation of the project reduces waste

water load by 35 % and sulphur dioxide emissions by 55 % from the present situation. The total cost estimate of the project is about 180 MFIM of which the share of local financing is about 100 MFIM and the share of foreign currency financing about 80 MFIM.

The environmental problems of **Volkhov aluminium factory** are mostly related to atmospheric and waste water emissions. In addition a 15 Mm^3 mountain of phosphorus gypsum is located close to the plant. The environmental problems of the plant are proposed to be reduced mainly by process technology measures, by purchasing electrofilters and by constructing a waste water treatment plant. Implementation of the project reduces sulphur dioxide emissions by about 60 % and organic load of the waste waters by about 40 % from the present situation. The total cost estimate of the project is about 15 MFIM of which the share of local financing is about 11 MFIM and the share of foreign currency financing about 4 MFIM.

The environmental problems of **Segezha pulp and paper mill** are mostly related to air and waste water emissions. The environmental problems of the mill are proposed to be reduced mainly by process technology measures, by purchasing electrofilters and by constructing a tertiary treatment unit for the waste water treatment plant. Implementation of the project reduces sulphur dioxide emissions by about 60 % and organic load of the waste waters by about 70 % from the present situation. The total cost estimate of the project is about 1,310 MFIM of which the share of local financing is about 270 MFIM and the share of foreign currency financing about 1,040 MFIM.

The environmental problems of **Nadvoitsy aluminium factory** are mostly related to atmospheric emissions. The factory is at the moment in process of installing of new flue gas scrubbers, thus reducing total atmospheric emissions by about 30 % but in order to comply with western standards construction of a new smelter is required. This is included in the proposed project. The total cost estimate of the project is about 600 MFIM which will all be in foreign currency.

The environmental problems of **Pitkyaranta pulp and paper mill** are related to atmospheric and waste water emissions. The environmental problems of the mill are proposed to be reduced mainly by process technology measures, by purchasing filters and by intensifying present waste water treatment. Implementation of the project reduces sulphur dioxide emissions by about 65 %, dust emissions by about 85 % and organic load of the waste waters by about 50 % from the present situation. The total cost estimate of the project is about 180 MFIM of which the share of local financing is about 30 MFIM and the share of foreign currency financing about 150 MFIM.

The environmental problems of **Tallinn pulp and paper mill** are related to waste water emissions that are proposed to be reduced by purchasing a new evaporation plant and by intensifying the waste water filtration plant. Implementation of the project reduces the organic load of the waste waters by about 75 % and suspended solids load by about 85 % from the present situation. The total cost estimate of the project is about 16 MFIM of which the share of local financing is about 6 MFIM and the share of foreign currency financing about 10 MFIM.

The environmental problems of **Kehra pulp and paper mill** are related to atmospheric emissions. The environmental problems of the mill are proposed

to be reduced mainly by process technology measures and by purchasing electrofilters. Implementation of the project reduces the sulphur dioxide emissions by 65-70 %. The total cost estimate of the project is about 33 MFIM of which the share of local financing is about 15 MFIM and the share of foreign currency financing is about 18 MFIM.

The area of Kohtla-Järve has plenty of polluting industry and about 200,000 inhabitants. Emissions include industrial waste waters containing phenols, atmospheric emissions, solid industrial wastes and municipal wastes among other things.

The environmental problems of the chemical industrial plant of PO Slantsekhim are proposed to be reduced by the renovation of the oil shale industrial plant and by implementing several waste water pre-treatment projects to allow the present, untreated portion of the waste waters to be led to the areal waste water treatment plant.

The environmental problems of Kiviõli chemical industrial plant are proposed to be reduced by purchasing new boilers for the power plant and by partially replacing oil shale with natural gas. These actions will reduce the atmospheric emissions by about 80 % from the present situation. Also the waste water treatment of the plant is proposed to be intensified.

The environmental problems of Pussi mechanical wood production plant are related to atmospheric and waste water emissions. The plant is converting from heavy oil to natural gas which will mostly eliminate the atmospheric emissions. Also the construction of a biological waste water treatment plant is proposed, thus allowing the treated waste waters to be led to the areal treatment plant without complications.

The areal waste water treatment plant in which all the waste waters of the above mentioned industrial plants and communities are treated is overloaded at the moment. The problem is proposed to be handled by the enlargement and renovation of the plant. Implementation of the proposed actions will reduce the load of the treatment plant to the sea by about 90 % in terms of BOD_5.

The environmental problems of Eesti Tsement cement factory at Kunda are related to atmospheric emissions. The machinery at the plant are proposed to be renewed, thus decreasing the dust emissions to the level allowed in norms for the Nordic countries.

The total cost estimate of the Kohtla-Järve area projects is about 675 MFIM of which the share of local financing is about 370 MFIM and the share of foreign currency financing about 305 MFIM.

Priorities of different projects

The priorities of different top priority projects has been determined in each environmental protection field separately, using their cost efficiency (eg. FIM/reduced BOD_5 t) and environmental effects as the main criteria. According to this classification the priorities of different air pollution projects are following:

1. Reduction of the environmental effects of the power plants in Narva

2. Reduction of the environmental effects of Kostamuksha combine

Correspondingly the priorities of different water pollution projects are following:

1. Implementation of the phosphorus removal at waste water treatment plants of the city of Leningrad
2. Connection of the direct discharging sewers to the collectors of the treatment plants in Leningrad
3. Reduction of the waste water load of the city of Tallinn
4. Reduction of the environmental effects in Kohtla-Järve district and Eesti Tsement
5. Construction of suburban waste water treatment plants in Leningrad
6. Reduction of the environmental effects of the town of Petrozavodsk

The project regarding the pre-treatment of plating factory waste waters in Leningrad cannot be rated with the other waste water projects by any comparable parameter, but it is in fact among the three most urgent projects. In conclusion to the priorities of the waste water projects it can be said that from the aspect of the whole Gulf of Finland and Baltic Sea, all the Leningrad waste water projects have great significance to a reduction of the total load.

No comparable parameter was found for the priorities of the waste projects. However, the hazardous waste management project in Leningrad and Leningrad region can be seen as the most urgent waste management project.

Owing to the great importance of technology measures in the reduction of emissions, the determination of priorities of industrial projects is also an impossible task. Therefore it has not been done.

Projected benefits of the action programme

The implementation of the environmental action programme takes at least ten years. The local as well as the transborder effects are significant. The proposed air pollution projects reduce the sulphur dioxide emissions in Estonia by about 60 %. Correspondingly the sulphur dioxide emissions of Karelia are reduced by about 35 %. In addition, in some parts of southern and eastern Finland the total sulphur depositions can be estimated to decrease by 10-20 %. Local decrements are even higher.

Waste water pollution projects decrease the total point-source load of the city of Leningrad in respect of BOD_5 and phosphorus by about 70 %. The corresponding figures for Tallinn are 80 % in respect of BOD_5 and 35 % in respect of phosphorus. The total point-source load discharged to the Gulf of Finland is reduced by about 35 % in respect of BOD_5 and by about 45 % in respect of phosphorus.

The implementation of the waste management projects reduce also the local load and the load on the Gulf of Finland. In addition, replacing the present improper burning of hazardous wastes by modern incineration plant reduces atmospheric emissions locally and on a larger scale. Organization of a hazardous waste collection system has also secondary effects on the operating condition improvements of the waste water treatment plants.

Financing the action programme

The total cost estimate of the environmental priority action programme is about 14.7 BFIM of which the share of local financing is about 9.3 BFIM and the share of foreign currency financing is about 5.4 BFIM. Financing the priority projects is mostly done by the locals, but all the projects include also western deliveries that can be technical consulting, contracting, direct machinery trade or training. Western deliveries also need western financing that is expected to be done by international development banks or other financing corporations. Paying back loans and giving guarantees will be the biggest problem when starting an individual project or the whole programme.

The communities have no chance of paying back foreign loans. Selling services closely related to tourism (eg. hotels), state financing or charging pollution rates of the industrial plants in foreign currency are proposed to obtain foreign currency for the financing of these projects.

Almost the only source of foreign currency for the financing of the industrial environmental projects are the enterprises themselves. However, there are problems due to the small return rate of foreign currency income to the enterprises. This makes the amounts of foreign currency at disposal insufficient for environmental investments. The upcoming economic reforms may bring a solution to this problem. A possible participation of foreign business associates would also bring new chances for financing.

From the regional point of view, it is the city of Leningrad that is in the most problematic situation, owing to the considerable number of communal proposed projects. The foreign currency income of the city is of no significance and there are no natural resources to organize barter trade. Therefore it is proposed that a separate feasibility study on the financing of Leningrad projects is made.

Foreign aid can be a part of foreign currency financing. The State of Finland will support these projects up to a certain extent. This support can be direct financial aid or softening the terms of credit.

Ministry of the Environment of Estonia
Ministry of the Environment of Finland
Swedish Agency for International Technical and Economical Cooperation (BITS)
Nordic Investment Bank
World Bank

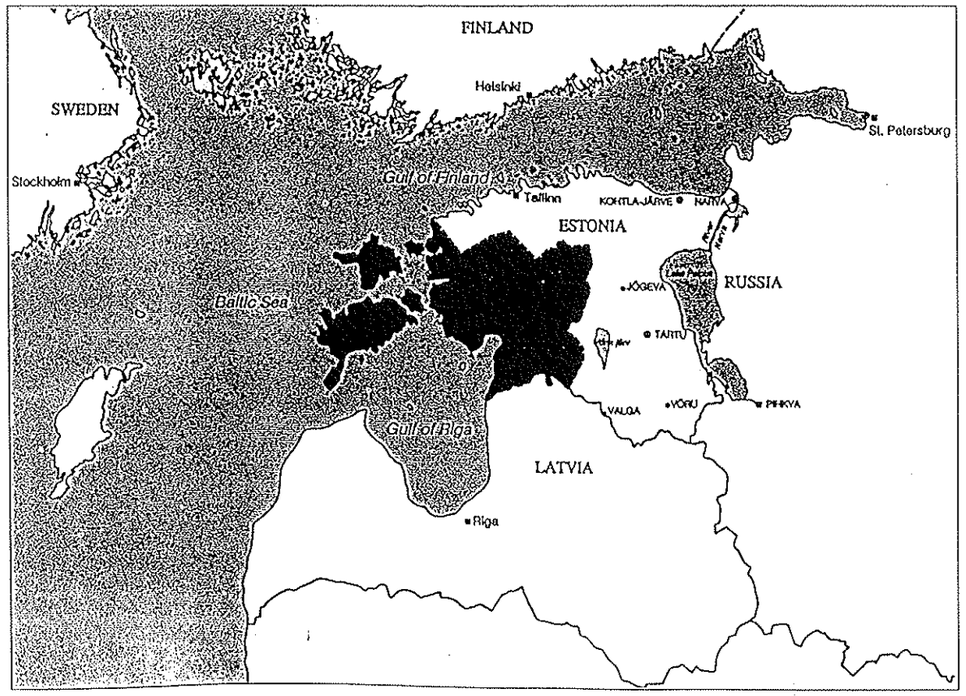
Baltic Sea Environment Programme

ENVIRONMENTAL PRE-FEASIBILITY STUDY OF THE WESTERN COAST OF ESTONIA

Volume 1

SYNTHESIS REPORT

August 1992



Plancenter Ltd
Swedish Environmental Research Institute (IVL)
Swedish Meteorological and Hydrological Institute (SMHI)
Ministry of the Environment of Estonia

Executive Summary

The objective of the "Pre-Feasibility Study of the Western Coast of Estonia" is to prepare an environmental priority action programme for the area, as one part in an overall action program for the Baltic Sea. The study provides sufficient information for decision makers, concerning state of the environment, for financing of the projects described in the study. The primary target is to control and reduce the present pollution situation of the Baltic Sea, in line with the Baltic Sea Declaration from 1990.

In conjunction between the Ministry of Environment, the Nordic Investment Bank, the World Bank, and the consultant it was decided that agriculture and a list of five hot-spots be given high priority in the formulation of the priority action programme. The list of hot-spots comprise the following two municipal pollution sources:

- Pärnu town waste water problems, and
- Haapsalu town waste water problems;

and the following two industrial sources:

- Paide Town Waste Water Treatment Plant, and
- Võhma Meat Combine Waste Water Treatment Plant.

In addition the following nature reserve was chosen as a hot-spot:

- Matsalu Bay Nature Reserve, including the Kasari river basin.

THE STUDY AREA

The study area covers 15,800 km² of agricultural lowlands in Western Estonia including the Estonian archipelago representing 35 % of the total Estonian territory. Western Estonia has a population of about 286,000 inhabitants (18 % of the total population of Estonia). About half of the population lives in town or settlements.

The main rivers in the study area are the Pärnu, draining 6,300 km² to the Gulf of Riga, and the Kasari, draining 2,700 km² to the Western Estonian archipelago. Other rivers in the area are of minor importance and represent a total drainage area of 2,800 km².

Annual precipitation in the area varies generally between 650 and 750 mm.

Soils in the region are mainly of limnoglacial origin, e.g. clays, but also sand. Bedrock consists of ordivicic and silurian limestone.

Agriculture is the dominating branch of industry and occupies about 34 % of the total study area. A major part of this (60 %) is arable land and the rest (40 %) grassland. Forests cover about 40 % and wetlands another 20 %. Heavy industry of notable size does not exist in Western Estonia, and food processing is the main industrial activity. Pärnu, Haapsalu and Viljandi have large slaughterhouses.

STATE OF THE ENVIRONMENT

Western Estonia is characterized by a moderate level of industrial activity—mainly of food-processing character—and a cultural landscape that, notwithstanding the many large agro-industries, has been little exposed to a truely modern, intensive agriculture..Considerable environmental disruption does, however, exist, but is generally restricted to the immediate surroundings of major pollution sources and the mouths of the larger rivers.

Being a predominantly agricultural area, it is not surprising to find high levels of nitrogen in the two main rivers. Phosphorus levels are considerably more moderate. High levels of faecal bacteria are common in many Western Estonian inland and coastal water bodies.

Ground water is the main source of drinking water in Western Estonia. As a result of a change towards more intensive agriculture over the last decades, the concentrations of nitrate in the ground

water have increased. Water from 20–30 % of these wells in the study area show nitrate concentrations above the permitted level of 45 mg NO_3^-–N/l.

As the majority of local industry is engaged in food-processing connected to agriculture and fish production, there is no reason to expect the area to be polluted by typical heavy industry effluents.

Little information is available on the presence of highly toxic, bio-accumulating compounds, such as metals, PCBs, DDTs, dioxins, etc. Therefore, this aspect should be further studied.

Air pollution is a minor problem. According to model calculations for the whole of Estonia the deposition of oxidized sulphur is 1,100–1,800 mg S/m² year and reduced nitrogen 600–800 mg N/m² year.

Western Estonia has 100-120 solid waste landfills. The annual generation of solid waste amounts to 500,000 m³. The landfills are generally operated without covers, leachate collection systems, or other treatment.

Impact of Pollution

Environmentally based health problems in Estonia can mainly be attributed to inferior water quality that has lead to restrictions on the recreational use of water bodies and to replacement of certain polluted local drinking water supplies with non-polluted sources.

Summaries of the impact from the present pollution situation on inland water bodies and coastal areas is presented in tables below:

Impact of pollution on different uses of inland water bodies.

Use	Local effects
Drinking water	Surface fresh water resources cannot be used without extensive treatment. High nitrate concentrations in shallow wells lead to public health hazards. Deep artesian aquifers used for supplying water are of suitable quality in towns and larger settlements.
Bathing	Considerable impact from eutrophication and faecal bacteria, especially close to pollution sources. Many inland waters are not suitable for bathing. Reduced potential for tourism in connection to fresh water systems.
Fishing	Fish kills occur regularly in many fresh water bodies due to oxygen depletion. Low commercial potential for fishing in inland waters.
Recreation and tourism	The pollution situation, mainly eutrophication, has reduced the potential for recreation and tourism in inland waters.

Impact of pollution on different uses of coastal water bodies.

Use	Coastal effects
Bathing	Considerable impact from eutrophication and faecal bacteria in immediate surroundings of point sources and river mouths. Beach closures and warnings issued by local authorities.
Fishing	Reduced fish catches due to the general pollution level. The composition of the catch is changed towards species with less economic value. Spawning and migration areas are affected by periodic oxygen depletion.
Recreation and tourism	The pollution situation reduces the potential for recreation and tourism, especially with regard to beach closures and inferior water quality for bathing. Need for improved tourist facilities.

As the present state of the environment for the main part of Western Estonia is relatively good, direct impacts on the economy are judged as being low. Local impacts are, however, far from negligible and if comprehensive actions for protection of the environment are not taken, a direct impact on the economy can be expected.

Estonian fish catches from the Gulf of Riga and the Saaremaa–Hiiumaa archipelago have declined somewhat over the last three decades, but, as in the case of tourism, it is difficult to establish the reason for this decline. In general, reported catches of fish are dependent on fishery regulations

and quotas and general conditions in the sea during the year. There are, however, several cases where abnormalities in fish and fish reproduction have been correlated to presence of toxic, bio-accumulating substances, such as metals, PCBs and DDTs.

Transport of Pollutants

According to pollutant transports calculated on the basis of monthly measurements of water flow and nutrient concentrations, 3,500 tonnes of nitrate nitrogen and 33 tonnes of phosphate phosphorus are annually transport to the sea from the Pärnu river. The corresponding figures for the Kasari river amounts to 1,800 tonnes nitrate nitrogen and 26 tonnes phosphate phosphorus.

The pollution transport to the Baltic proper from Western Estonia amounts to less than 1 % of the total load. The transport of nitrogen from the study area to the Gulf of Riga comprise about 5 % of the total load on the Gulf; phosphorus 3 %.

However, both the Kasari and the Pärnu rivers show high aerial specific values of nutrient transport.

SOURCES OF POLLUTION

A simple pollution transport model was used to estimate the relative contribution from different pollution sources. The result is shown below:

Estimated Pollutant Budget Based on Model Calculations

Activity	Phosphorus		Nitrogen		BOD	
	t/a	%	t/a	%	t/a	%
Agriculture	72	22%	8,640	76%	?	?
Forest and forestry	23	7%	1,163	10%	?	?
Industry+Municipal.	123	38%	855	8%	4,877	(79%)
Small towns+settlements.	30	9%	181	2%	504	(8%)
Rural living	71	22%	427	4%	790	(13%)
Fish farming	1	0%	8	0%	?	?
Atmospheric deposition	5	2%	27	0%	?	?
TOTAL	326		11,300		6,171	

Municipal and Industrial Sources

Most municipal and industrial effluents are discharged to the recipient with little or no prior treatment.

There are 15 waste water treatment plants in Western Estonia of which the four largest—Pärnu, Paide, Haapsalu and Võhma—were included in the list of hot spots. The discharges from the selected plants exceed 60,000 m^3/d, representing 80 % of the total discharge from point sources in Western Estonia, 96 % of the total BOD pollution load and about 90 % of total phosphorus and total nitrogen loads from municipal and industrial point sources.

A summary of pollution loads from hot spots and other point sources is presented below:

Total discharge of pollutants from point sources in Western Estonia (real total values are likely to be somewhat higher).

Point Source	Flow (Mm^3/a)	Load (t/a) BOD_5	N_{tot}	P_{tot}
Pärnu	14.6	3,400	500	66
Paide	4.6	1,100	170	26
Haapsalu	3.9	715	105	20
Võhma	0.8	520	58	9
Others	5.8	236	85	14
Total	29.7	5,971	918	135

Pärnu Town Waste Water Problems

The waste water treatment plant in the town of Pärnu serves about 55,000 inhabitants. The plant, constructed in 1980, was originally meant to be a mechanical treatment plant with pre-treatment and pre-sedimentation units. The process has later been supplemented by a biological phase which was completed 1989 but was not operating until 1990.

The machinery, equipment and automatization of the plant are out-of-date. Only 65 % of the total volume of waste water is discharged to the treatment plant. The industrial pre-treatment facilities are old and not functional. The high percentage of industrial waste water causes operational risks.

The basins of the treatment plant are of poor quality. The metal used in the treatment plant is black iron and it has not been corrosion protected properly. The de-watering of the sludge has not been working for some time. Machines and appliances from Western Europe lack spare parts. Some very important instruments do not function. The control of the operation is not sufficient and the water laboratory is lacking tools and equipment.

Haapsalu Town Waste Water Problems

The Haapsalu waste water treatment plant serves 11,000 out of 16,000 inhabitants in the town. Several industries are not connected to the treatment plant. The total length of the sewers in Haapsalu is 16 km and in the system there are altogether 10 pumping stations and a mechanical treatment plant.

The existing waste water treatment plant is only mechanical and very antiquated. Only 2/3 of the residential areas are connected to the treatment plant. The industry has no pre-treatment in the factories before discharging the waste water to the network. All the pumping stations are old and need regular maintenance.

Paide Town Waste Water Treatment Plant

The Paide Town Waste Water Treatment Plant, taken in use in 1979, is a waste activated sludge plant. It was first meant to serve Paide Dairy Plant waste waters but its excess treatment capacity was put to use by connecting Paide town sewers to the plant.

The plant is old-fashioned and its machinery is out-of-date. The plant lacks capacity to treat both dairy and municipal waste waters. In average, about 5,000 m^3/d of the total amount of 11,000 m^3/d is led to bypass. Insufficient nutrient removal is due to lack of aeration volume and chemicals. The present process is very hard to control due to the lack of instrumentation. pH-shocks of dairy waste waters disturb the biological treatment. Sludge digestion does not work. Sludge dewatering in drying beds is also very problematic.

Võhma Meat Combine Waste Water Treatment Plant

There are 2,000 inhabitants in the village. Võhma Meat Combine is the main industrial enterprise in the area. The combine has its own waste water treatment plant that was established in 1975.

The plant is old-fashioned and its machinery is out of date. The quality of the construction works is bad. Present organic load entering the plant is over twice the planned level, hindering effective treatment. Sludge management is problematic: drainage beds are not big enough, other options have not solved the problems either. The sludge problem has caused trouble with local authorities.

Agricultural Sources

Agricultural land in Western Estonia covers about 5,560 km^2, or 34 % of the total study area. Non-point source pollution in Western Estonia is to the main extent a result of agricultural activities.

The use of pesticides increased considerably during the 1970s and 1980s to reach a peak in the mid 1980s. Since then, however, the use has decreased by a third—mainly due to the present economic difficulties. In 1990 only 1.5 kg/ha of active substances were used, which is considerably below the European average. The active components in the pesticides are mainly copper and zinc.

Seen from a Baltic basin perspective, intensity of animal breeding in the study area could be characterized as moderate. The average animal density of 0.6 AU per ha total agricultural area in Western Estonia, (or 1.0 AU/ha arable land) should be compared to corresponding figures for the former Soviet parts of the Baltic basin (0.8 AU/ha), Denmark (2 AU/ha), and Germany (1.3 AU/ha).

In 1990, 210 kg commercial fertilizers and 20 tonnes manure was spread on each hectare arable land. This corresponds 168 kg nitrogen per hectare (72 kg from commercial fertilizers and 96 kg from manure) and 75 kg phosphorus per hectare (52 kg from commercial fertilizers and 23 kg from manure).

Manure is usually stored in uncovered piles on nearby fields. Only 35 % of the animal farms have manure storages. These are usually open air storages with concrete bottoms, in some cases with roof coverings.

Since manure up till now has been regarded as a waste product, government legislation and standards on handling of manure do not exist. Due to the lack of manure storage facilities, manure is not often spread on frozen fields in the winter.

Leaching of nitrogen and phosphorus is summarized below:

Nitrogen and phosphorus leaching from agricultural activities and forests in Western Estonia.

Activity	Area (km^2)	Nitrogen (t/a)	Phosphorus (t/a)
Agriculture	3,200	9,600	80
Forests and forestry	6.500	2,000	30
Total		11,600	110

The Matsalu Bay Nature Reserve

Matsalu Bay is a shallow bay cutting deep into the Western coast of Estonia. The Kasari River, draining about 3,200 km^2, discharges here. The Bay is subjected to eutrophication due to high input of nutrients of agricultural origin. Due to the numerous and varied bird fauna and the picturesque landscape the Bay and surrounding meadows, marshes, and reed-beds of the Kasari River delta is included in the list of internationally important wetlands protected under the Ramsar convention.

However, due to high loads of nutrients and organic material originating in the immediate surroundings and the Kasari river basin, the Bay is threatened by a rapid eutrophication process and disquieting reports of high levels of mercury found in fish, as well as the presence of PCB and other bio-accumulating substances.

The sources of pollution could be attributed to agricultural activities in the Kasari river basin. On an annual basis, point sources account for roughly 100 tonnes of nitrogen and 10 tonnes of phosphorus. About 40,000 people live in the Kasari River catchment area. Waste water treatment facilities are sparse, and the ones that exist work only partially. Several medium size industries are also located in the area (in Rapla, Märjamaa, Järvakandi and Lihula). Pollution could also originate from

solid waste dumps in the catchment area. Of particular interest are pollution sources located in the immediate surroundings of the Bay.

INSTITUTIONAL FRAMEWORK

Estonia follows a decentralized model of environmental management where each district, county and town is responsible for maintaining environmental qualities within its own area of jurisdiction. Environmental administration in Estonia is divided between a central administration under the Ministry of Environment (MoE), a local Environmental Protection Offices (EPOs) under the municipal governments and an national level environmental inspection.

Environmental Legislation and Regulatory and Control Measures

Up till now, most of the legislation and regulations concerning environmental protection and utilization of natural resources are derived from the old Soviet union-wide laws and standards. A new set of domestic laws and regulations, similar to those adopted in the West, are currently being prepared by MoE and read in the Parliament. As a result of these changes, many activities affecting the environment are taking place in a legislative vacuum between the old and the new systems.

For the enforcement of environmental policy, Estonia relies presently on a mix of fixed command and control instruments (e.g. environmental standards) and market based financial instruments. The carrying idea of the system is to provide incentives to polluters for pollution abatement by penalizing the inefficient use of natural resources and excessive disposal of pollutants, and, at the same time, to generate revenues for environmental protection activities. Taxes and fines are collected from agricultural, municipal and industrial polluters.

Standards

The environmental standards currently used were inherited from the former Soviet Union. They are generally more stringent than EC directives or HELCOM recommendations but unrealistic. The use of standards, which are in practice impossible to enforce, contributes to a general disregard of environmental laws and regulations.

Effluent limits are established after negotiations between the EPO and the polluter. The limits agreed on are individually set for each polluter based on what can reasonably be achieved with existing water treatment facilities, or after reasonable investment in new facilities.

Monitoring

The basic monitoring strategy used in Estonia was worked out 15–20 years ago under decree from Moscow, and up to the present, these Soviet monitoring standards have been used in Estonia with little change. The former Soviet water quality control system aimed to reduce pollution to the level of that could be assimilated by the recipient. Water quality standards were therefore only set for the recipient. One measured (four to six times annually) only the diluted effluent concentrations, well downstream from point sources.

Comprehensive environmental planning hardly exists in Estonia, perhaps partly as reaction to the excesses of the Soviet planning system. Instead, environmental issues are handled on a case by case basis.

The lack of comprehensive environmental planning increases the risk that scarce funds will not be rationally allocated.

PROPOSED ENVIRONMENTAL PRIORITY ACTION PROGRAMME

Measures to decrease loads of phosphorus and organic material should in the first hand be directed towards industry and municipal sewerage, while measures to decrease nitrogen loads should primarily be directed towards agriculture.

However, due to the nature of the eutrophication problem and bio-accumulation of toxic substances more comprehensive approaches than only "end of pipe" solutions should be sought, including careful investigations of non-point source pollution. In this chapter the priority action programme suggested by the consultant for implementation at the hot-spots and in agriculture are described.

The following objectives have been set up by the consultant for the priority action programme. By the end of 1995:

- all waste water should be biologically treated;
- all industrial effluents should be pre-treated;
- HELCOM recommendations for BOD removal should be met;
- manure storage capacity in the Kasari river catchment area should provide for 8 months of manure production; and
- reed harvesting capacity should match annual growth of reeds.

By year 2010

- waste water treatment plants should meet HELCOM recommendations with regard to biological-chemical treatment; and
- through application of improved agricultural practices, nutrient leaching should be reduced by 50 %.

Pärnu Sewage Treatment Plant

The target of this action programme is to renovate the existing sewage treatment plant and the sewerage network in order to meet the treatment requirements set in the HELCOM recommendations.

The suggested action programme includes measures that will reduce the BOD_5-load with 97 %, the nitrogen load with 70 % and the phosphorus load with 90 %, until year 2010.

Haapsalu Sewage Treatment Plant

The target of this action programme is to renovate the existing sewage treatment plant and the sewerage network in order to meet the treatment requirements set in the HELCOM recommendations.

The suggested action programme includes measures that will reduce the BOD_5-load with 95 %, the nitrogen load with 60 % and the phosphorus load with 90 %, until year 2010.

Paide Sewage Treatment Plant

Instead of building an extension with a capacity of 10,000 m^3/d, constructing a new plant provided with a capacity of about 12,500 m^3/d and closing the old plant down is proposed. Some parts of the old plant are proposed to be used as equalization basins against dairy waste water pH-chocks.

The suggested action programme includes measures that will reduce the BOD_5-load with 96 %, the nitrogen load with 75 % and the phosphorus load with 78 %, until year 2010.

Võhma Sewage Treatment Plant

Due to the uncertainty regarding present production and pollution rates, the first proposed action is to conduct a feasibility study concerning future ways of production and pollution loads at Võhma Meat Combine. Constructing a new secondary treatment unit and abandoning the old plant is also proposed, in order to achieve stringent recommendations regarding the effluent.

The suggested action programme includes measures that will reduce the BOD_5-load with 94 %, the nitrogen load with 75 % and the phosphorus load with 90 %, until year 2010.

Matsalu Bay

The Matsalu Bay and the Kasari river basin constitute a perfect study object for a demonstration study with the following aims:

- to investigate how different agricultural action programmes, proper waste water treatment and accurate management of solid waste dumps affect the runoff and transport of agricultural pollutants; and
- to seek better knowledge about the situation around toxic, bio-accumulating substances.

The study should cover present and future land use in the areas draining to the Bay and the possibility of limiting the pollution both from point and non-point sources. Studies should also be conducted with regard to the effects in the recipient of different pollutants.

In conjunction with the results from the study measures for improving the environmental situation in the Matsalu Bay may be undertaken, including policy actions, agricultural practices aimed at decreasing the loss of nutrients, as well as proper waste water treatment.

PROJECTED BENEFITS

Pollution loads after short and long term improvements are presented below:

Discharge of pollutants from hot-spots after improvement by 1995 and 2010. (t/a)

	BOD_5		Nitrogen		Phosphorus	
	1995	2010	1995	2010	1995	2010
Agriculture and forests	?	?	9,000	4,500	90	45
Matsalu Bay	1,100	1,100	1,000	1,000	40	40
Pärnu s.t.p.	240	350	290	340	48	18
Paide s.t.p.	230	110	120	55	16	7
Haapsalu s.t.p.	55	60	90	76	14	3
Võhma s.t.p.	50	30	28	13	5	1
Total	1,675	1,650	10,530	6,000	213	114
Reduction	78 %	78 %	11 %	50 %	27 %	61 %

The five hot-spots are assumed to represent about half of the phosphorus load and about a quarter of the nitrogen load from Western Estonia. The total first phase action programme will reduce the annual load of phosphorus with about 80 tonnes, corresponding to about 40 % of the present load from hot-spots, or about one quarter of the calculated total discharge of pollutants from Western Estonia. The annual load of nitrogen will be reduced with about 1,300 tonnes, roughly corresponding to 40–50 % of the present load from the hot-spots and of about half of the calculated total loading from Western Estonia.

The action programme will improve the sanitary conditions close to point sources, reduce the biological production of organic material in inland and coastal waters, and decrease the risk for oxygen poor conditions during low discharges and water flows.

INVESTMENT COSTS

The total investment costs required for pollution abatement at hot-spots have been estimated separately as short and long term improvements, shown below:

Summary of total pollution abatement costs for hot-spots improvements. (MECU)

	1995	2010	total
Agriculture and forests	-	80	80
Matsalu Bay	30	-	30
Pärnu s.t.p.	10	8	18
Paide s.t.p.	3	1	4
Haapsalu s.t.p.	13	12	25
Võhma s.t.p.	3	1	4
Total	59	102	160

Cost Efficiency

The table below shows unit costs of load reduction and gives a rough idea of the cost efficiency of the pollution abatement actions:

Summary of the cost efficiency after short term improvements by 1995 and 2010. (ECU/kg/year)

	BOD_5		Nitrogen		Phosphorus	
	1995	2010	1995	2010	1995	2010
Agriculture and forests	?	?	?	18	?	1,780
Matsalu Bay	-	60	30	30	750	750
Pärnu s.t.p.	3.1	6	46	112	539	375
Paide s.t.p.	3.9	4	68	36	340	215
Haapsalu s.t.p.	19.7	38	867	862	2,170	1,470
Võhma s.t.p.	6.2	8	97	82	725	462

The actions suggested for Pärnu, Paide and Võhma s.t.p. are lowest relative to pollution reduction. Agriculture is the biggest source for nitrogen pollution, therefore mitigatory actions directed towards agriculture not only prove cost efficient, but will moreover reduce the total nitrogen discharge from Western Estonia dramatically.

Haapsalu s.t.p. has the highest costs per reduced unit pollution. The relatively high cost for pollution abatement must be carefully evaluated with regard to the potential for tourism and utilization of curative mud in the Haapsalu area.

In order to achieve the nutrient removal, tertiary treatment must be implemented in the treatment plants. The cost efficiency of these additional actions is summarized below:

Summary of the cost efficiency of additional investments for tertiary treatment until 2010. (ECU/kg/year)

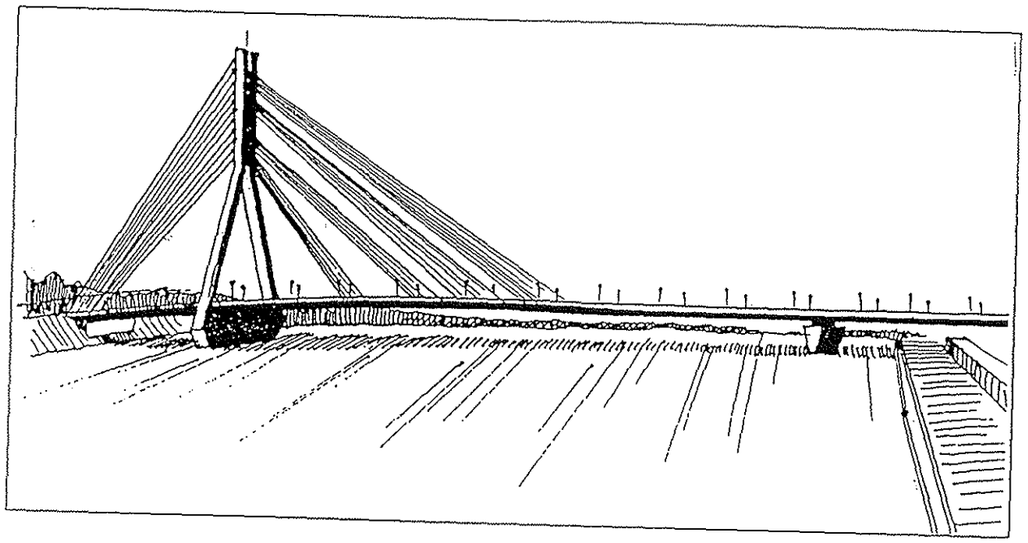
	BOD_5	Nitrogen	Phosphorus
Pärnu s.t.p.	-	-	277
Paide s.t.p.	6	13	78
Haapsalu s.t.p.	-	857	1,090
Võhma s.t.p.	40	53	200

Implementation of the tertiary treatment is most cost effective in Paide and almost as effective in Võhma. In Pärnu the costs of phosphorus pollution reduction are reasonable, but there is no additional decrease for nitrogen removal. In Haapsalu, the implementation of the full nutrient removal is to be considered as very expensive. Simultaneous, phosphorus removal is not that expensive to implement in Haapsalu.

Baltic Sea Environment Programme

NIB
NORDIC INVESTMENT BANK

Pre-Feasibility Study of the Gulf of Riga and the Daugava River Basin



Volume 1: Synthesis Report

June 1992

Carl Bro a|s
Consulting Engineers and Planners

Carl Bro Group

In cooperation with

LREPC
Latvian Republic Environmental Protection Committee

SDCP
Swedish Development Consulting Partners

IVL
Swedish Environmental Research Institute

SMHI
Swedish Meteorological & Hydrological Institute

NLK-Celpap

EXECUTIVE SUMMARY

The study was initiated as part of the Baltic Sea Environment Programme. This programme was intensified by the acceptance of the Ronneby declaration, signed by the Baltic states on 3 September 1990. The declaration called for the establishment of a High Level Ad Hoc Task Force under the auspices of the Helsinki Commission.

The work plan of the task force calls for the preparation of a series of pre-feasibility studies of priority areas to provide analyses of specific areas and form the basis for later investment programmes. The present study is one of these prefeasibility studies.

The study was financed by a Danish/Swedish grant of DKK 1.0 million/SEK 1.5 million. The Nordic Investment Bank acted as Client's representative and signed the contract for the study with a Danish-Swedish-Latvian group. Carl Bro a|s of Denmark acted as main consultant with 1 Latvian and 4 Swedish sub-consultants.

The Terms of Reference describe the study area as being the Gulf of Riga in the Republic of Latvia and Daugava River basin in the Republic of Byelorussia, the Republic of Latvia and the Russian Federated Socialist Republic.

In agreement with the Nordic Investment Bank, it was decided to concentrate the efforts in the territory of the Republic of Latvia, adding to the study area the catchment areas of the rivers Lielupe, Venta and Gauja inside the republic. This was done partly due to the political situation in the area, partly because the procurement of data from the two then Soviet republics proved very difficult/impossible.

The emissions from Byelorussia, Russia and Lithuania would then, to the extent existing data would allow this, be treated as point sources at the borders of the republic of Latvia.

The study was undertaken in the period June 1991 through February 1992 with the majority of the field work completed before the coup d'etat of 19 August. Financial limitations have made it impossible to redo any part of the work.

The study appears in two volumes; the present volume one, Synthesis Report, and volume two, Technical report. The present volume attempts to keep technical text to an absolute minimum. Readers with an interest in the technical side and the methodology are referred to volume two.

The area of Latvia is 64,589 SQKM, the population 2.6 million, excluding former Soviet military personnel and their dependants.

The study should, i.a.w the Terms of Reference, be based on existing data. Data in Latvia are not plentiful. Before the creation of the Latvian Republic Environmental Protection Committee in 1990, all data were collected by "all Soviet Union" organisations. The original data were transmitted from Latvia to the relevant centres outside the republic. The only chance to use these data were if they happened to be published afterwards. No verification, based on the original data, was possible.

When the Latvian Republic Environmental Protection Committee started work in 1990, it also started collecting data. But the equipment to do so was not always of the desired standard, and staff had to be trained. On top of all this, managers in the union owned enterprises were not in all cases cooperative. So a combination of very few measurements and some uncooperative enterprises have made the data more uncertain than for most similar studies.

This must be kept in mind all through the use of the study.

An environmental legislation was introduced in Latvia in August 1991. The environmental protection act defines the responsibilities of the Latvian Republic Environmental Protection Committee, the Council of Ministers and the local authorities. One untraditional feature of the present administrative set up is that the environmental protection committee comes under the authority of the parliament, not the central administration. This may change once the Latvian administration has been reorganized.

Part of the enforcement system in Latvia is fines and fees for emission of various components. This system will have to be kept constantly updated in step with the economic development.

The impact on the ecology in Latvia can be divided in two: water and air. Rivers, lakes and the Gulf of Riga all show signs of influence from as well organic matter as nutrients. In the air, the recommended maximum limits are either close to being or are exceeded.

The impact to health is difficult to determine without much more data and studies than those presently available. The average life expectancy in Latvia is lower than in Western countries around the Baltic, and infant mortality is higher.

The most likely influence from the environmental situation can be found in the many occurrences of infectious intestinal diseases, where unclean water is the most likely reason. In some areas with point source polluters, a higher than average occurrence of respiratorial diseases is found. This can be due to air pollution, but just as well to a low housing standard. In some of the same areas, a higher than average sickness in children is registered. This can be due to pollution, but also to the fact that in these industrialised areas, a higher than average number of children attend institutions.

Thus all indications that the environmental situation influences the Latvian economy in the areas of tourism, fishing and recreation. The effects can not be quantified.

The suggested priority programme consist of actions at point sources, actions towards none point sources and accompanying measures. Even if the latter may be problematic to finance they can achieve wide ranging results, e.g. by changing the attitude of the population.

The suggested priority programme includes investigation of the following items:

Slokas Pulp and Paper Mill

Latvbiofarm Pharmaceutical Plant, Olaine

Radio and Telephone Exchange PLant "VEF", Riga

Electro Apparatus manufacturing Plant "RER", Riga

Centralized Treatment of Sludge with Heavy Metals

Daugavpils Waste Water Treatment Plant

Liepaja Waste Water Treatment Plant

Riga Waste Water Treatment Plant, Phase II

Emergency Assistance in Procurement of Chemicals and Spares for Water Purification Plants

Other aspects of the programme are accompanying measures, where monitoring and management programmes need to be established. Also institutional strengthening and human resources development should be important parts in the programme.

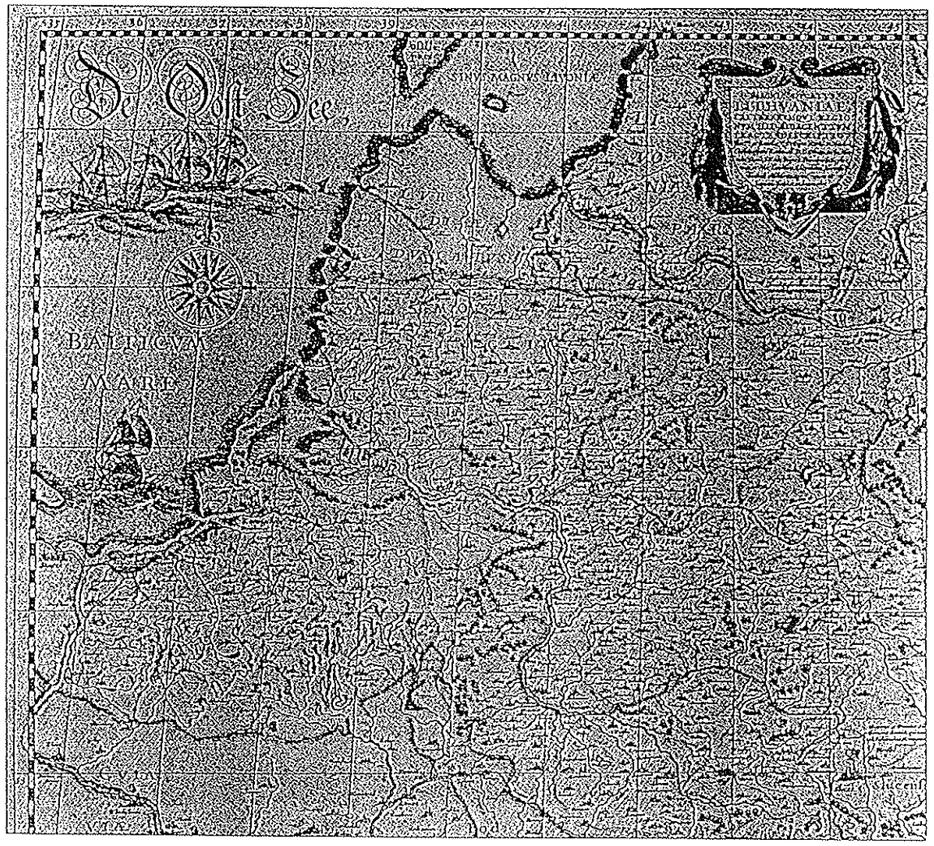
If the programme is initiated, it is probable that the situation in waters, as well sea as inland, will improve with a beneficial effect on e.g. the tourist industry. This would in turn benefit the economy. The same would an increase in the possible fish catches in the Gulf of Riga.

An improvement in water quality is also very likely to reduce the number of infectious intestinal diseases. An influence on as well children's sickness as the respiratorial diseases could also very well be a result, especially if further funds are made available to reduce air pollution. But as previously mentioned, a number of social factors can also influence in these areas.

NORDIC INVESTMENT BANK

BALTIC SEA
ENVIRONMENT PROGRAMME

Baltic Sea
ENVIRONMENT
PROGRAMME



Pre-Feasibility Study of the Lithuanian Coast and the Nemunas River Basin

SYNTHESIS REPORT

May 1992

K-KONSULT
WATER PROJECTS AB

in Joint Venture with

Krüger Consult
I KRÜGER CONSULT AS

ÅF-IPK AB
MFG Environmental Research Group
National Bacteriological Laboratory

RAMBØLL & HANNEMANN A/S
WATER QUALITY INSTITUTE

LITHUANIAN REPUBLIC ENVIRONMENTAL PROTECTION DEPARTMENT
PPA/PPROJECT

PRE-FEASIBILITY STUDY OF THE LITHUANIAN COAST AND THE NEMUNAS RIVER BASIN

0 EXECUTIVE SUMMARY

0.1 Background

The study has been made at the request of the Nordic Investment Bank by a consulting group consisting of K-Konsult Water Projects AB and I Krüger AS with other Swedish and Danish Consultants as subconsultants and with the cooperation of the Environmental Protection Department in Vilnius, Pramproject in Kaunas and the University of Klaipeda.

The objectives of the study have been to prepare a priority action programme to pre-feasibility level to permit decisions on the financing of priority investment projects to control and reduce the pollution of the Baltic Sea from the Lithuanian coast and the Nemunas River Basin.

The study has been made according to the Terms of Reference with modifications agreed at the Review meetings.

The report consists of two volumes:

- Volume 1, Synthesis Report
- Volume 2, Technical Report

0.2 Description of the study area

The study area includes the Baltic Coast of the Republic of Lithuania, the Curonian Lagoon in both the Republic of Lithuania and the Russian Federation and the drainage basin of the Nemunas River in the Republic of Lithuania, the Republic of Poland, the Republic of Byelorussia and the Russian Federation.

The total area of the Nemunas Basin is 98 200 km^2 (Lithuanian part is 46 600 km^2 or 47.5%). The total area of the Curonian Lagoon is 1 580 km^2 (Lithuanian part 410 km^2 or 25.9%). The average annual amount of precipitation is 615 mm.

Glacial deposits prevail on the surface of the Nemunas River basin. Wetlands and peatlands cover ca 10% of the territory. Forests cover ca 30% of the total area.

The study area can be divided in the Upper course basin, the Mid-course basin, the Lower course basin and the Delta and Basin coast.

The population in the study area is 5.4 million inhabitants (Lithuania 3.1 millions).

The industrial production has after World War II been concentrated in large industrial agglomerations with raw materials, fuel and equipment imported from the former USSR. The most important types of industry are: machinery industry, textile industry, and food industry.

The agriculture is important. The process of re-privatization has started in 1990. The agricultural products are exported to the industrial regions of Russia.

The railway is the most important transport mean in the study area. The key railway nodes are Vilnius and Baranovichi. Vilnius is linked by four-lane motorways with Kaunas, Klaipeda, Panevezys and Minsk.

0.3 Environmental status

The number of person equivalents connected to the sewerage system discharging to the Lithuanian part of the Nemunas River is 3.1 mill PE. The total number of inhabitants living in the 69 seweraged areas are 2.2 millions. About 65% of those are connected to sewers.

In Lithuania the daily discharge of registered wastewater is 925.000 m^3. As it can be seen from table 0.1, 35 % is biologically treated, 40 % is mechanically treated or of similar quality while 25 % is untreated. 90 % of the untreated wastewater is discharged from Kaunas.

Type of plant	Plants	m^3/day	Pct
Biological	41	320 000	35 %
Mechanical	15	370 000	40 %
No treatment	7	230 000	25 %
Other	6	5 000	<1 %
Total	69	925 000	100 %

Table 0.1. Type of treatment.

In table 0.2 is shown the amount of wastewater discharged from six levels of plant sizes. It is remarkable that the discharge from the 5 largest plants is 69% of the total discharge.

Size in 1 000 PE	Plants	m^3/day	Pct.
larger than 200	5	640 000	69 %
100-200	4	80 000	9 %
25-100	13	120 000	13 %
10-25	11	55 000	6 %
2-10	18	25 000	3 %
less than 2	18	5 000	<1 %
Total:	69	925 000	100 %

Table 0.2. Discharged wastewater from six levels of plants.

If the BOD, total-N and total-P could be reduced to 15 mg/l, 12 mg/l and 1.5 mg/l respectively, the amounts of BOD, tot-N and tot-P would be reduced in the following way. (Table 0.3)

	Present discharge ton/d	Future discharge ton/d	Reduction %
BOD	103	14	86
tot-N	32.1	11.3	65
tot-P	7.0	1.4	80

Table 0.3. Reduction of pollutants.

A treatment according to Helcom standards in Vilnius, Kaunas and Klaipeda will reduce the present discharge of BOD from point sources with 72%.

The industrial load from major industries is estimated to 1.7 mill PE.

One of the largest problems in connection with treatment of sewage and industrial wastes in the cities of Lithuania is the treatment and storage of sludge. In most cases, the primary and secondary sludge is only dewatered on sludge drying beds, and as the drainage capacity is low, the sludge drying beds tend to change into sludge lagoons.

The industrial team concluded that the effluent flows from the industries are high and should be reduced. Internal methods to reduce the discharges of different substances are generally not practised. As some industries are of old design and rebuilding them will require a very high investment cost.

Within the food industries, there are some mills with considerable discharges of BOD.

The use of mineral fertilizers in Lithuania is high, especially phosphorus fertilizers. The leaching of nitrogen seems to be small in comparison with Danish conditions.

The pesticide consumption in Lithuania is too high on an area basis. No data on leaching of pesticides have been available.

The large farm with cattle, pigs and poultry are important point sources. The total pollution potential in the manure is 90 000 ton N per year and 20 000 ton P per year.

Every year approximately 1 million tons of pollutants are discharged into the air in Lithuania. Traffic is responsible for more than 50% of the air pollution. Air treatment facilities collect approximately 1.7 million tons per year.

After the Declaration of Independence in March 1990 the Lithuanian Parliament has passed various laws relevant to Environmental Protection, including a new Law on Environmental Protection.

At the central level, the Environmental Protection Department (EPD) has been formed. At the regional level there are eight Regional Environmental Protection Agencies, engaged with control and monitoring. Many municipalities have also formed their own environmental departments.

04 Analysis of impacts on ecology, health and the economy

The load of pollutants from municipal waste water, industrial waste water, agriculture and fish farms are estimated to 89 900 ton BOD_5 per year, 57 500 ton Nitrogen and 3 590 ton Phosphorus per year.

The load from Byelorussia is approximately 30 000 ton BOD_5 per year, 7 000 ton Nitrogen and 1 000 ton Phosphorus per year, according to monitoring data from the Nemunas River.

The calculated river transport (including Byelorussia) based on monitoring data amounts of 150 000 ton BOD_5 per year, 20 000 ton N per year and 3 300 ton P per year.

The physico-chemical water quality does not seem to be deteriorated. Average BOD_5-concentrations of 3-7 g/m^3 are measured in the river and only at rare occasions the dissolved oxygen drops below 60% saturation.

In som areas there is an indication of an impact on the macrofauna by toxic substances.

A PC-based dynamic one-dimension model has been used for simulation of hydrodynamics and water quality to study the changes in water quality after a change in waste loads resulting from the proposed actions.

The Curonian lagoon is important for its fisheries. The influx of pollutants with the Nemunas River is high. In addition a pollution load from the City of Klaipeda is discharged in the Northern part.

Due to the high pollution loads the Curonian lagoon has lost most of its original capacity to retain and/or degrade incoming pollutants. Secondary pollution is also produced in the lagoon.

The pollution load transport to the Baltic Sea is considerable. (A recent estimate is BOD_5 140 000 tonnes/year, N-total 32 000 tonnes/year, P-total 1 800 tonnes/year, Cu 100 tonnes/year) The seaside resort of Palanga adds to the pollution during the summer season.

The bottom sediments are to an increasing extent covered by sand and mud. An increasing trend for mercury contamination is indicated.

The ecosystem is under severe stress due to the heavy loading and important fish-food organisms are virtually absent in the southern part of the lagoon. The influx of organic material, plant nutrients and potentially toxic compounds must be drastically reduced.

High concentrations of nitrates in the ground water are caused by the mineral fertilizers and can be a public health risk. Air pollution in the industrial districts (e.g. Kedainiai district) may cause respiratory diseases.

0.5 Proposed environmental priority action program

It is considered necessary to reduce the pollution affecting the Lithuanian Baltic coast and the Curonian lagoon.

It is concluded that the most severe effects and/or risks are found in the Curonian lagoon and in the coastal waters at the same time it is also of great interest to reduce the pollution in the Nemunas River Basin. It is necessary to avoid discharge of raw sewage (in many cases also containing industrial wastes) into the Nemunas River and its tributaries.

The following types or groups of contaminants should be given high priority.

- phosphorus (due to its role in eutrophication of the Curonian lagoon)
- nitrogen (mainly due to the toxic effects of ammonia)
- coliforms (as an indicator of fecal, possibly pathogenic bacteria)
- BOD (as an indicator of various, possibly hazardous contaminants)
- heavy metals (in particular metals with high aquatic toxicity).

Both points sources (here defined as all significant sources in a city or an industrial complex) and non-point sources (agriculture, livestock breeding) should be considered.

The hot spots are defined as the major point sources of emissions of contaminants. They can consist of municipalities with industries connected to the municipal collector (composite hot spots) or industries with direct discharges to a receiving stream, lake or coastal water. However, since impact on the environment and health can be caused by either emissions to receiving waters or emissions to the atmosphere, also air emissions have been considered.

The consultants have selected the following priority list. EPD has also worked out a priority list. The priority is indicated by numbers with paranthesis.

		EPD
Highest priority:	Kaunas	(1)
	Klaipeda	(2)
	Vilnius	(4)
High priority:	Kedainiai	(8)
	Palanga	(5)
	Panevezys	(7)
	Siauliai	(3)
	Jonava	-
	Alytus	(6)

By the construction of a treatment plant in Kaunas and upgrading the existing plants in Vilnius and Klaipeda the total municipal point source discharges (including connected industries) can be reduced as follows.

	From	To
BOD	38 000	10 000 t/year (70 % reduction)
Tot-N	12 200	9 500 t/year (20 % reduction)
Tot-P	2 500	2 100 t/year (15 % reduction)

It is also necessary to use accompanying measures such as

- policy, legislation and regulatory actions
- administrative actions and enforcement programmes
- economic instruments (as pollution tax)
- management programmes
- monitoring
- institutional strengthening and human resources development.

06 Benefits from the proposed action programme

Upgrading of Vilnius treatment plant will result in reductions of 36% and 13% for BOD_5 and inorganic-N in the Neris River.

Actions in the Kedainiai region lead to reductions of 54% and 72% for inorganic-N and inorganic-P in the downstream part of the river.

Actions in Panevezys lead to a reduction of 42% for BOD in the downstream part of the river.

Installation of phosphorus removal in Alytus will have a benefical effect on the Kaunas lake.

Actions in Kaunas and the pulp and paper mills in Neman and Sovetsk will lead to a significant decrease in the BOD-concentrations in Nemunas River, and also a certain decrease of ammonium. Downstream of Kaunas the BOD is expected to decrease by about 1.5 g/m^3. In stretches between discharge and full mixing, the improvement will be much more significant.

For the Curonian lagoon a reduction of Nitrogen and Phosphorus in Kedainiai is of great importance.

Continued studies of concentrations of various contaminants and their turnover in the Curonian lagoon as well as the mass transport from the lagoon to the Baltic Sea are needed.

It is not possible to reduce the pollution of the Baltic Sea by 50% from the present situation (1991) with the proposed actions.

Only the reduction of BOD_5 seems close to fulfil the demand of the HELCOM agreement. Thus, it can be forseen that measures to reduce the non-point source pollution must be taken to achieve the objectives of the HELCOM agreement.

Important benefits to the economy are e.g. industrial internal measures turning a polluting substance into a marketable product. Improved water quality will lead to a more profitable fishery. Even the tourism might benefit from the upgrading of sewage treatment plants.

07 Capital and recurrent costs

The investment and recurrent costs for the proposed actions at the hot spots have been calculated.

The costs have first been calculated for secondary treatment and then the costs for adding tertiary treatment have been added to get the total costs.

The costs have been divided into foreign and local costs.

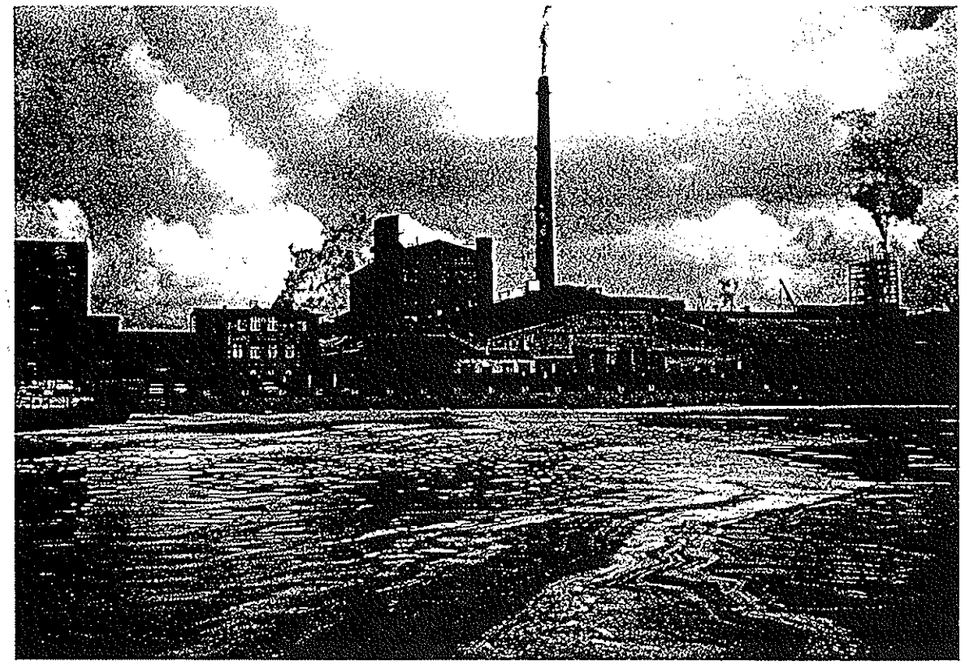
NAME Town	SEC. (Mecu)	TER. (Mecu)	TOT. (Mecu)	FOR. (Mecu)	LOCAL (Mecu)	RECUR (Mecu)
Kedaini	0	6	6	2.4	3.6	1
Panevezys	0	9	9	2.4	3.6	4
Siauliai	22	3	25	10	15	1.5
Alytus	7	6	13	5	8	2
Grigiskes (I)	-	-	5	3.2	1.8	0.3
Kaunas	75	10	85	35	50	5
Vilnius	23	17	40	16	24	6
Grodno	-	-	-	-	-	-
Klaipeda	22	5	27	11	16	2.5
Cardboard (I)	-	-	30	19	11	0.8

Table 0.4 Investment and recurrent costs.

NORDIC INVESTMENT BANK

Baltic Sea Environment Programme

European Bank
for Reconstruction and Development



PRE - FEASIBILITY STUDY OF THE KALININGRAD REGION AND THE PREGEL RIVER BASIN

SYNTHESIS REPORT

APRIL 1992

Norconsult
Norconsult International A S

in joint Venture with JAAKKO PÖYRY

0. EXECUTIVE SUMMARY

0.1 STUDY AREA

The study area comprises the whole of Kaliningrad administrative area (Kaliningrad oblast) which is an isolated part of the Russian Federation. Included in the area is a part of north-eastern Poland, that makes up part of the Pregel River catchment area outside Kaliningrad.

Kaliningrad region is the most western region of the Russian Federation. It has a territory of about 15 100 km². with a population of about 800 000. The majority of the population lives in towns. The city of Kaliningrad is by far the largest town with approximately 400 000 inhabitants.

The Kaliningrad region has a varied economic structure. Industry is well developed, as are the agriculture, fisheries, tourism, etc. sectors. The most predominant industry in the region is the pulp and paper industry with a total annual production capacity of about 400 000 tons. Two major pulp and paper mills are located in the city of Kaliningrad and two others can be found in the northern towns of Neman and Sovetsk.

0.2 STATE OF THE ENVIRONMENT

Data on fresh water quality in the Kaliningrad Region and the Polish part of the Pregel catchment area are available from different local sources, in particular from the Kaliningrad Committee for Ecology and Nature Conservation, Kalkompriroda. To supplement and complete this information, the consultant took standard water samples which were then analyzed at the Norwegian Institute for Water Research (NIVA) laboratory.

The data show that all water courses in the Kaliningrad region have high concentrations of nutrients and organic matter which cause excessive algal growth and reduced oxygen concentration. The situation is most severe in Pregel River, from Chernyakhovsk through the city of Kaliningrad to the Gulf of Kaliningrad. River Neman is less polluted than Pregel River due to its greater flow of water.

The sampling programme indicates low discharges of heavy metals, but the concentration of micro-pollutants, especially of PCBs, is a cause for major concern.

The algae biomass is in general large. The high level of eutrophication supports a high biological production in the rivers. There are several species of freshwater fish in the rivers, but diseases and skeletal abnormalities have been identified in coastal fish populations in the Gulf of Vislinsk. The anadromous fish species are particularly affected by the pollution situation.

The almost closed Bay that includes the Gulfs of Vislana and Vislinsk is still a very productive brackish water body. The oxygen saturation level is normal, due to constant mixing of water. However, in the main inlet to the Bay, River Pregel, oxygen deficiency is prevalent throughout the year. The concentrations of nutrients in the Gulfs are considerably higher than those found in the Baltic Sea.

0.3 POLLUTION SOURCES

There are approximately 200 major water consuming enterprises in the Kaliningrad region. Few of these have installed effluent treatment plants, and most of the used process water is discharged with little or no treatment. Many, especially smaller, enterprises discharge their waste water directly into the municipal sewage system, but the treatment efficiency of the municipal plants is often inferior to that of the industries.

The main cities in the region, Kaliningrad, Sovetsk, Chernyakhovsk and Gusev, all have insufficient sewage treatment facilities. The sewage system in the city of Kaliningrad is by far the most important pollution source in the area. About 40% of the BOD_{tot} and 90% of total phosphorous discharged from point sources in the region is generated from this system. The treatment efficiency at the existing municipal plants is low.

There are four major pulp and paper mills in the region; two in Kaliningrad, one in Sovetsk and one in Neman. With the exception of the Kaliningrad city sewage system, they are the most polluting point sources in the region. The problem in all the mills centres around the outdated process technology and the lack of waste water treatment. It is estimated that their annual BOD_{tot} loading is about 55 000 tons and their ammonium nitrogen loading about 3 220 tons per year. These values correspond to about 60% and 50% respectively of the total point source loading from the Kaliningrad region.

Kaliningrad harbour is one of the most important ports in Russia. As such the potential pollution is high.

Agriculture is a major source of point and non-point pollution. Milk and meat production predominate. While the general usage of fertilizers is low, handling practices and storage facilities of manure and mineral fertilizers create major pollution problems.

The solid waste disposal area in the city of Kaliningrad is an open landfill dump for municipal and industrial waste without control or treatment facilities.

0.4 POLLUTION LOAD

The Russian report to the Helcom Task Force gives a total load for 1987 of nutrients and organic matter from the Kaliningrad region as:

- 1 864 tons of tot-P
- 6 729 tons of tot-N
- 92 869 tons of BOD

Table 0.1 presents a pollution budget for nutrients. The budget is based on unit load figures and general process and production estimates.

Table 0.1

Nutrient budget for the input into the Gulf of Kaliningrad and the Gulf of Kursh from sources in the Kaliningrad region and the Polish part of the Pregel catchment area.

Source	Phosphorus tons	Nitrogen tons	BOD tons
Gulf of Kaliningrad			
Sewage	460	2 200	11 000
Agriculture	970	14 580	n.a.
Industries	50	2 000	25 000
Service	70	500	4 000
Tributaries from Poland	160	1 400	n.a.
Total load	1 710	20 680	> 40 000
Gulf of Kursh			
Sewage	110	500	3 000
Agriculture	710	8 200	n.a.
Industries	30	7 000	41 000
Service	20	80	1 000
Total load	870	15 780	> 45 000
Total load from Kaliningrad and Pregel Catchment into the Gulfs	2 580	36 460	> 85 000

It is estimated that the retention of nutrients in the gulfs is about 25% for phosphorous and 35% for nitrogen. This gives a total annual load of nutrients, from the Kaliningrad Region into the Baltic Sea, of about 2 000 tons of phosphorous and 24 000 tons of nitrogen.

These figures differ considerably from the loading figures previously reported for the region. The main reason for this discrepancy is that the table above includes the total load from agricultural sources. In addition, some of the figures on industrial discharge have previously been underestimated. Since there does not appear to have been any major changes in activities or pollution abatement measures since 1987, the above figures may present a more realistic picture of the 1987 situation in the Kaliningrad Region. We propose that the above figures are used as baseline figures for the Kaliningrad region.

0.5 SELECTION OF STUDY POLLUTERS

At the start of the study all major sources of water pollution were examined and prioritized. Twelve polluters were selected jointly by Kalkompriroda and the consultant for more detailed study; four were to be investigated in less detail; and two were included in the assessment based on findings from the field work.

The polluters studied were as follows:

1. Sewage system of the city of Kaliningrad
2. Sewage system of the town of Chernyakhovsk
3. Sewage system of the town of Sovetsk
4. Sewage system of the town of Gusev
5. Pulp and Paper Mill - 1, Kaliningrad
6. Pulp and Paper Mill - 2, Kaliningrad
7. Pulp and Paper Mill, Sovetsk
8. Pulp and Paper Mill, Neman
9. Ship Yard "Yanter", Kaliningrad
10. Fish Process Factory, "Baltrybcombinat", Svetliy
11. Dairy Factory, Kaliningrad
12. Railway Wagon Factory, Kaliningrad
13. Sewage System of the town Svetlogorsk
14. Amber Factory in Yanterniy
15. Industrial complex PO "Systema" in Kaliningrad.
16. Kaliningrad Waste Disposal Area
17. Kaliningrad harbour
18. Oil Bunkering Station at the Fisheries Port

Detailed descriptions of the above, including their activities, production and pollution problems, plans for change of activities, pollution abatement, etc. can be found in Chapter 5 of this report and in the Technical Report. The plans are also assessed and recommendations given.

0.6 ACTION PROGRAMME

Based on the analyses and conclusions in Chapter 5 an Action Programme is recommended. The most critical pollution hot spots have been determined to be:

a. Kaliningrad City Sewage System
b. Pulp and Paper Mill No. 1 in Kaliningrad
c. Pulp and Paper Mill No. 2 in Kaliningrad
d. Sovetsk Pulp and Paper Mill
e. Neman Pulp and Paper Mill
f. Kaliningrad City Solid and Hazardous Waste System
g. Oil Bunkering Station, Kaliningrad Harbour

The Kaliningrad City Sewage System is by far the largest single source of water pollution in the region. A new biological treatment plant for Kaliningrad and a new main collector have been under construction since

1976. Action is needed in order to accelerate project progress and to make the system operational as soon as possible.

A serious limiting factor to the general development of the paper industry is the availability of wood. Before the development possibilities of these mills can be measured, two detailed studies are need: one on wood supply and the other on the pulp and paper market. In addition the mills are old and technically and economically unsatisfactory. To invest in them in their present form would be an economic risk.

The Action Programme proposes that pulp production at Pulp and Paper Mill No 2 in Kaliningrad is developed using a magnesium-based sulphite process, provided that there is enough wood available in the region or neighbouring areas. In the case of the other three mills the preliminary conclusion is that they will not be able to survive as pulp producers in a new economy. However, it may be feasible to develop the paper production capacity at these mills and the present action programme is based on this scenario.

The solid waste system in Kaliningrad city is included in the priority list in spite of the lack of information both on the waste generated in the area, the details of managing the landfill, and on the environmental impacts. It is, however, quite clear that the present situation is unsatisfactory and that severe environmental impacts can be suspected.

At the Oil Bunkering Station in the Kaliningrad harbour a well defined pollution problem has been identified. With limited investment and some technical assistance, it is possible to solve a major pollution problem, but the costs and impacts cannot be quantified at this time.

In the agricultural sector efforts should be placed on reducing the discharges from the point sources. This can be done through information, establishment of economic incentives or disincentives, or by legal or regulatory measures. Specific priority should be given to the termination of the extremely polluting practise of discharging the surplus of manure and other agricultural waste directly into water courses.

There are strong indications that organic micro-pollutants, in particular PCB and PAH, represent a serious problem in the area. Before actions can be planned, an investigation into the size of the problem and the sources of this pollution has to be carried out. The level of dioxin pollution in the region should also be investigated. A detailed monitoring programme should be executed in the Pregel River and Gulf of Vislinsk. There is also a need to upgrade the laboratory's capacity and competence on micro pollutants.

A river basin plan for Pregel river and a management plan for the Gulfs of Kaliningrad, Vislinks and Vislana, should be developed.

There is a general need for improvement of sewage treatment facilities all over the region. Studies should be made and strategies developed to facilitate investment and better performance in this sector.

Advanced training for those working with environmental problems in industry and municipal waste water treatment should be expanded by arranging for specially tailored courses taught by western experts.

When the general economic situation has improved and becomes more stable the system of users' fees, etc. for municipal water supply, sewage and waste services will need to be revised. This is necessary in order to strengthen the financial capacity for reconstruction and improvement.

Environmental information dissemination and people's participation in environmental decision-making should be enhanced.

The priority action programme as presented in Chapter 6, will reduce the pollution load to the Baltic Sea from the Kaliningrad region significantly. Table 0.2 shows the expected load reductions from the point sources, while Table 0.3 shows the expected reductions due to regulatory actions in the agricultural sector.

Table 0.2

Reduction in the Annual Pollution Load of the Proposed Abatement Measures at Point Sources. Tons per Year.

Priority hot-spot	P	N	BOD
a. Kaliningrad City Sewage System	450	500	20 000*
b. Pulp and Paper Mill No. 1 in Kal.	8	80	10 000
c. Pulp and Paper Mill No. 2 in Kal.	4	40	4 000
d. Sovetsk Pulp and Paper Mill	7	3 000	34 000
e. Neman Pulp and Paper Mill	7	2 600	5 000
f. Kaliningrad City Wastes System	-	100	4 000
g. Oil Bunkering Station, Kal.	subs. reduction in oil discharges		
Total	> 476	> 6 320	> 77 000

* According to the described plans (cf. 5.2.1) the load reduction of BOD from this source will be 34 000 tons per year. This was, however, under the condition of no changes in production structure at the two pulp and paper mills and that all their discharges were treated at the City Sewage Plant.

Table 0.3

Reduction in Annual Load from Aricultural Point Sources
Tons per Year
(figures reduced due to retention and denitrification)

Action	P	N
Stop in direct discharges of agr. waste and manure to watercourses.	1 000	5 760
50% reduction in discharges from other agr. point sources.	230	1 750
Total	1 230	7 510

The total action programme will reduce the annual load of phosphorous to the gulfs by about 1700 tons, or 66%, of the total loading. The annual load of nitrogen will be reduced by about 14 000 tons, or 38% of the total loading. The reduction of the load of organic matter can not be calculated since the loading from agriculture is unknown. However, the proposed actions will remove all the major industrial and municipal sources of BOD.

As proposed the programme will come close to achieving the objectives of the Baltic Sea programme in the Kaliningrad region. To reduce the load of nitrogen to fully meet the objectives, action has to be taken on the use of fertilizer and manure in the agricultural sector, and nitrogen removal has to be implemented at the Kaliningrad Sewage Treatment Plant.

Baltic Sea Environment Programme

Pre-Feasibility Study of the Vistula River Basin and Baltic Coast of Poland

Part I Synthesis Report

Prepared for the World Bank

Financed by
BITS - Swedish Agency for International Technical and Economic Co-operation
and
The Danish Environmental Protection Agency

Prepared by
SWECO COWIconsult VKI Vistula Joint Venture
in association with Hydroprojekt and Stolica

With the support of
Ministry of Environmental Protection, Natural Resources and Forestry,
Republic of Poland

Copenhagen, Stockholm and Warsaw
November 1992

EXECUTIVE SUMMARY

1 BACKGROUND

1.1 Part of the Baltic Sea Environmental Programme

The Pre-Feasibility Study of the Vistula River Basin and Baltic Coast of Poland is part of the activities initiated by the Baltic Sea Environment Conference held in Ronneby, Sweden in September 1990. This study is one of eight parallel pre-feasibility studies that constitute the basis for the Baltic Sea Joint Comprehensive Environmental Action Programme, a special report on recommended actions to reduce emissions and restore the Baltic Sea to a sound ecological balance.

This Pre-Feasibility Study has been sponsored by the governments of Denmark and Sweden and has been elaborated by the SWECO - COWIconsult - VKI Vistula Joint Venture in association with Hydroprojekt and Stolica, Warsaw. The World Bank has been the executing agency for the consultant's work.

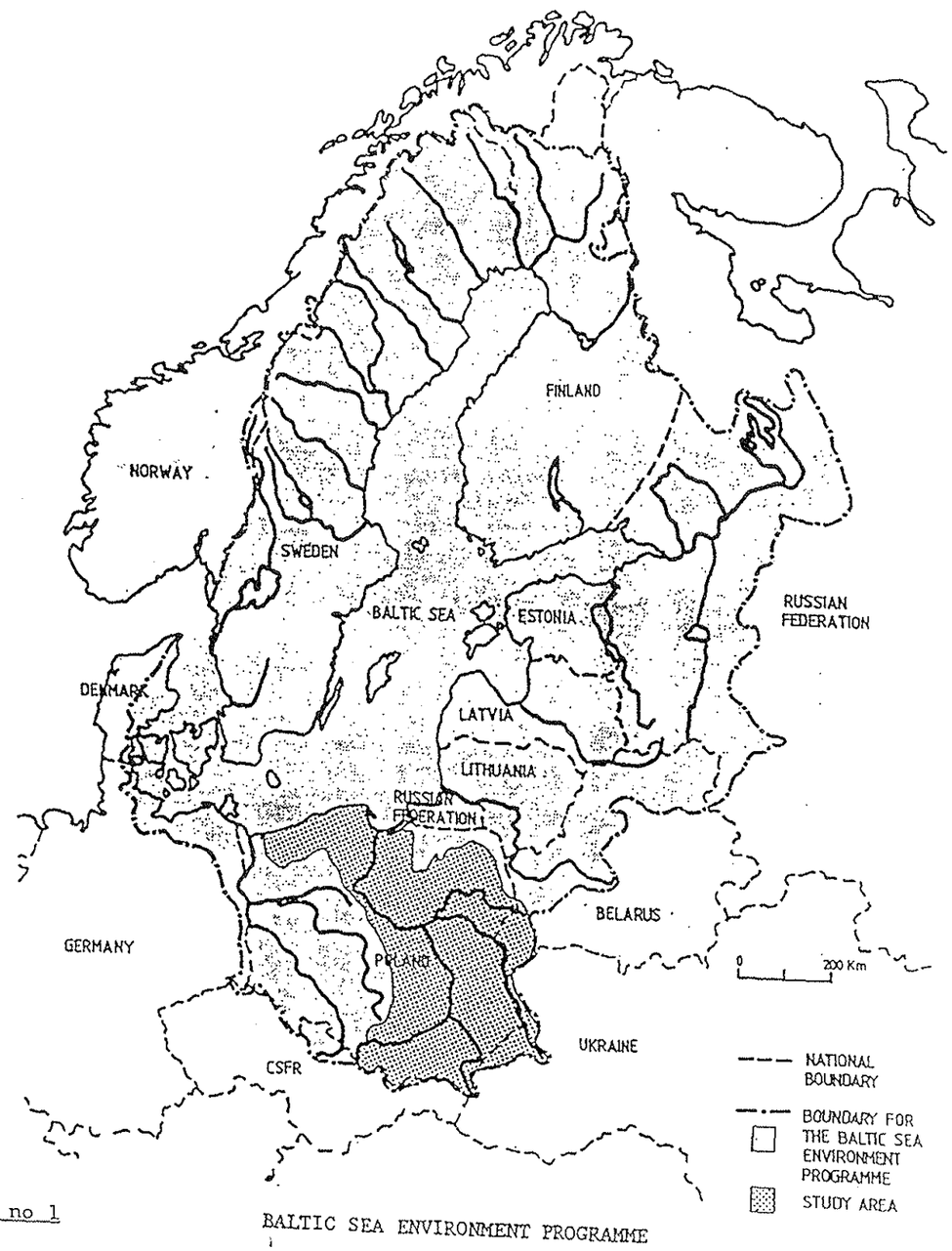
The objectives of this study are to provide an overview of environmental problems and causes in the study area, identify and assess possible investments and institutional actions, and to recommend a priority action programme to control and reduce the pollution of the Baltic Sea from the entire drainage basin of the Vistula River and the Baltic Coast of Poland. This includes the target of adoption of measures by the countries in the region to reduce the 1987 emission levels by 50 percent by 1995 in line with the 1990 Baltic Sea Declaration.

1.2 The Study Area

The study covers the two discrete sub-regions 1) the Vistula River Basin and 2) the coastal drainage area covering a 60-70 km wide strip along the Polish coastline from the border to the Russian Kaliningrad area to the mouth of Odra River (see map 1). The total land area is 220,000 km^2 with a population of 26.7 million people. 89 percent of the Study Area is found within Polish territory (see map 2). The rest is parts of the Czech and Slovak Federal Republic (CSFR), Ukraine and Belarus.

The Study Area represents 14 percent of the total catchment area of the Baltic Sea, 33 percent of its population, and the largest portion of the agricultural activity in the catchment area. The conditions of the Baltic Sea are therefore significantly dependent on the influence from the Study Area and its decision makers.

BTB55.ifm/VU0/920918.DSR

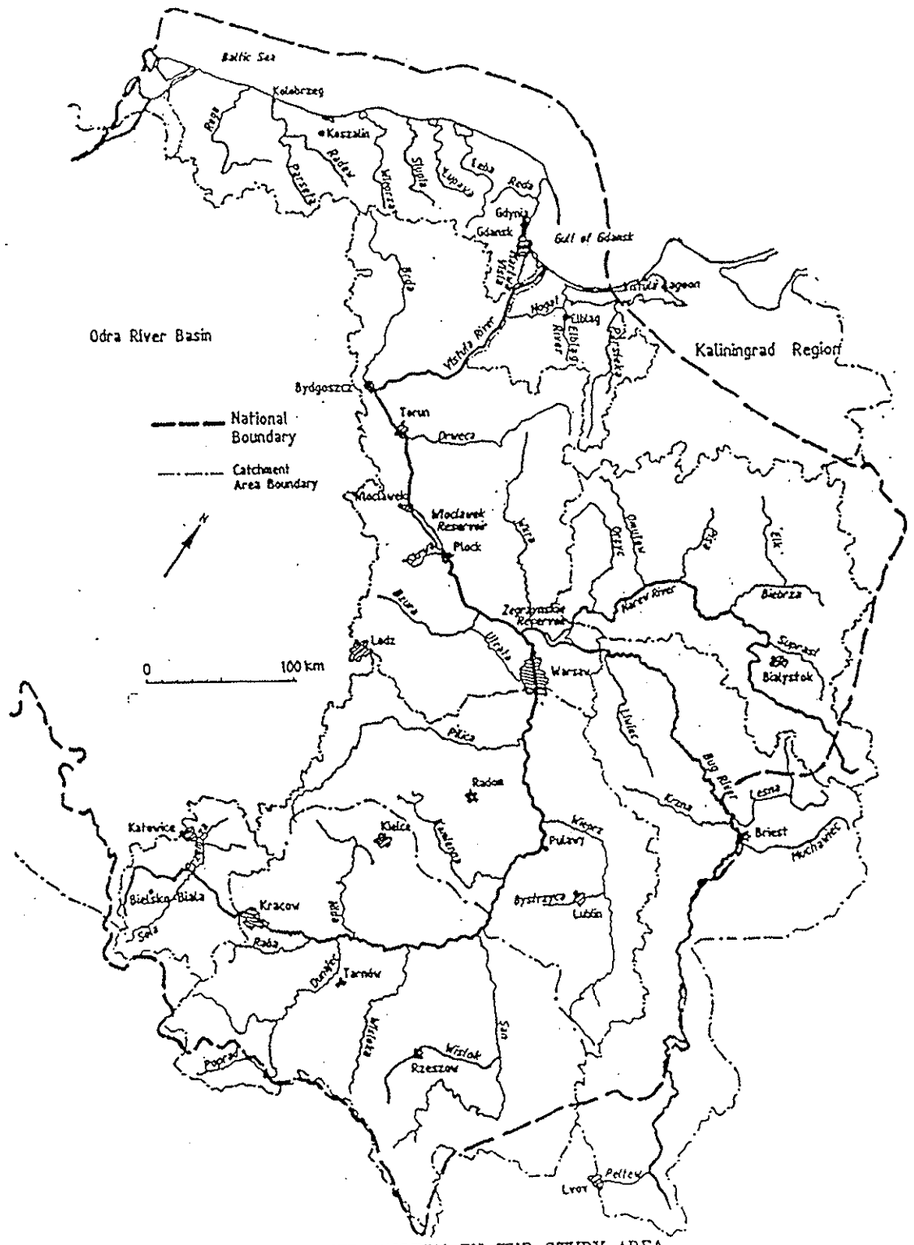


Map no 1

BALTIC SEA ENVIRONMENT PROGRAMME

BTB55.ifm/VU0/920918.DSR

7 432491U



Map no 2

RIVER SYSTEM IN THE STUDY AREA

There are concentrations of population in the middle and southern part of the basin with agglomerations around Warsaw, Krakow and Katowice in Poland, and Lvov in Ukraine. The Polish coastal area is less densely populated except the Gdansk-Gdynia agglomeration. The location of industry in the study area follows mainly the same concentration pattern as the population.

Agriculture covers 65 percent of the land area with generally uniform distribution of both field crops and livestock. The most intense agriculture can be found on Lower Vistula River and in the most western part of the coastal area. Small and medium privately-owned farms dominate the central and southern part of Poland. Large state and cooperative farms dominate in the northern part of Poland and in Belarus and Ukraine.

Poland, which is a littoral state of the Baltic Sea, is a signatory to the Helsinki Convention.

1.3 Alarming Environmental Situation

The situation of dense population and high industrialization has caused an intense, in some cases irresponsible, utilization of natural resources, jeopardizing the availability of clean water and fresh air.

Measures against water pollution are not well developed. The municipal wastewater from about 1/3 of the population in Poland is not treated at all, and most of the existing treatment is of low efficiency. The situation in industry is similar with lack of sound technology and high discharge of pollution from most of the plants. Several major factories have no appropriate treatment.

Handling of manure from livestock farms causes water pollution in several parts of the Study Area. Most rivers are affected by nutrient runoff from crop land. At present, the runoff is moderate but if the application of commercial fertilizers should approach the Western European level, the load to the rivers would increase considerably.

The discharge of improperly treated wastewater from industrial and domestic sources causes deterioration of the quality of the river water. Only lakes and rivers in the upper parts of the drainage basin show a water quality sufficient for production of drinking water. Most of the surface waters within the Study Area are unsuitable as drinking water supply and large parts of the rivers are too polluted for any utilization. River bathing is restricted or prohibited throughout most of the Vistula basin.

The discharge of saline water from coal and sulphur mining in the headwater areas of tributaries of the Vistula river makes the river water unpalatable for drinking all the way to Warsaw and too corrosive for industrial use. As a result of the salinity and wastewater pollution, long distance water supply systems are

built in the upper and middle Vistula region. These water projects are very expensive, and the whole approach diverts investment resources from cleaning up the causes of river pollution.

Discharges of untreated wastewater bring large amounts of bacteria and other pollutants to coastal rivers, and directly to the Baltic Sea. Fishing, recreation and other uses of coastal areas are hampered by pollution. The Polish beaches of the Baltic Sea are valuable areas for the domestic and international tourism, which is now restricted by beach closures.

Atmospheric emission of dust, sulphur dioxide (SO_2), nitrogen oxides (NO_x), heavy metals and organic compounds is severe in heavily industrialized areas, especially around Katowice and Krakow. Coal-burning power plants and metallurgical industries are the largest point sources, and coal combustion for heating represents the largest non-point source for dust. Vehicles contribute significantly to air pollution, including NO_x, carbon monoxide (CO), particulates, volatile organic compounds (VOC), and lead (Pb), and are anticipated to increase due to greater use of trucks for transport and expanded number of private vehicles.

Inefficient and poorly maintained combustion processes, lack of clean technology and emission control equipment, poor maintenance of existing control equipment, and poor fuel (coal) quality are the main reasons for the heavy industrial air pollution. High lead-content in gasoline, high sulphur-content in diesel fuel, lack of emission control and poor maintenance are causes for high vehicle emissions. Leaks, lack of controls and large heat losses from buildings and heat-supply systems are responsible for a large part of the air pollution emissions from heat generation.

1.4 Pollution of the Baltic Sea

Water quality in the Baltic Sea is threatened by nutrients, heavy metals and persistent organic substances conveyed by direct discharge to the sea, by rivers or by atmospheric deposition to the sea water.

Discharges of the nutrients nitrogen and phosphorus increase plankton growth and possibly algal blooms. Large amounts of oxygen are consumed when the plankton is decomposed. This has led to oxygen deficiencies and possibly production of hydrogen sulphide, and especially in deep parts of the Baltic proper, which have had major consequences for the fauna over the last few decades. Nutrients are significant components of runoff from agriculture and discharge from the municipal sewerage and some specific industries which lack reduction measures.

The agricultural sector contributes 45 percent of the total nitrogen load reaching the Baltic Sea from the study area. This is more than the load from all wastewater point sources. About 1/6 of the agricultural load is ammonia

deposited on the Baltic Sea which has evaporated from animal manure and fertilizer in the study area. The present pollution from agriculture is low by West-European standards due to low fertilizer use and large number of very small farms. The load from agriculture can be expected to increase substantially if fertilizer use increases to typical West-European levels without major changes in farm practices and land use.

Reliable information is lacking on discharges of heavy metals in the Study Area. However, data from the mouth of the Vistula show very high values for most of the analyzed metals. Some heavy metals are essential trace elements in vital biochemical substances and processes. However, in just a little too high concentrations, most of them are toxic to life and can cause damage to flora and fauna. Heavy metals transported to the sea by rivers have both natural and human sources. Increased metal concentrations originate from several human activities with the metallurgical industry and use of leaded gasoline as the main sources.

Persistent organic substances belong to a group of man-made organic chemicals. They are not readily degradable and hence long-lived. The levels of these substances in the environment will gradually rise as long as they are entering the environment at a faster rate than they decompose. The substances having biological effects are bio-accumulating, that is they are taken up by living organisms where they can accumulate to concentrations tens of thousands of times higher than in the water itself. Toxic effects on the fauna in the Baltic Sea have mostly been caused by the chlorinated organic compounds. DDT and PCB are perhaps the most well-known substances of this group, but there are large amounts of other chlorinated pesticides and by-products from the organo-chemical industry.

Monitoring of persistent organic substances is rare in the Study Area, but there are industrial branches present which can be expected to discharge these toxic substances if adequate remedial measures are not taken. The major pulp and paper and chemical industries along Lower Vistula are threats to the Baltic Sea. Several chemical industries in the Katowice area and one major industry in the Bzura River area are primarily threats to the downstream river sections but have also long distant effects.

The correlation between the quantities emitted in one point and the discharge to and deposition on the Baltic Sea has been studied. Many substances are reduced through decomposition and deposition during transport by river water. As an example, out of 1 kg of nitrogen discharged in Warsaw, only 0.5 kg arrives in the Bay of Gdansk. For the same volume, 1 kg of N, discharged in Krakow only 0.3 kg, and in Lvov 0.1 kg, reaches the sea. For other substances the transport factors are usually lower. Most heavy metals deposit not very far from the outlet in the river, lake or sea. Their further transport depends on biological activity, and the deposit from one year can contribute small amounts to the transport over many years.

Atmospheric emissions are transported long distances and dispersed on a regional scale. Only about 4 percent of NO_x emissions from a point source in Warsaw end up in deposition on the Baltic Sea, but some of the largest point sources of airborne pollution reaching the Baltic Sea are found in the southern part of the Study Area. Out of the 40 highest N-deposition-to-Baltic point sources, 27 are located in the southern part of the study area contributing 2200 tons N per year the Baltic Sea.

Nonetheless, the biggest part of the total load on the Baltic Sea emanates from waterborne sources with the major impacts from sources within short distance of the sea. Tables E1 and E2 summarize the loads and sources to the Baltic Sea from the Study Area.

Table E1 WATERBORNE CONTRIBUTION OF BOD, NITROGEN AND PHOSPHORUS TO THE BALTIC SEA FROM THE STUDY AREA.

Vistula River values based on average measurements for the period 1987-90. Coastal river and direct discharges estimated.

	BOD_5		Tot-N		Tot-P	
	tons/year	percent	tons/year	percent	tons/year	percent
Vistula	153,000	78	100,000	82	5,800	73
Coastal Rivers and direct discharge	43,000	22	22,000	18	2,200	27
Total Study Area	196,000	100	122,000	100	8,000	100

Table E2 NITROGEN LOAD ON THE BALTIC SEA FROM THE STUDY AREA BASED ON MODEL CALCULATIONS FOR A NORMAL YEAR

Water-borne		
- point sources	52,000 tons/year	36 percent
- non-point sources	70,000 tons/year	49 percent
Air-borne		
- point sources	11,000 tons/year	8 percent
- non-point sources	10,000 tons/year	7 percent
Total	143,000 tons/year	100 percent

The biggest contributors of nitrogen to water are urban populations representing 45,000 tons/year and agriculture representing 52,000 tons/year.

2 PROPOSED ACTIONS

2.1 General Approach

Environmental protection aspects should be a part of most activities and decisions of the modern society.

The environmental action programme presented by this study is divided into two main features

- Investments in real facilities like treatment plants control existing pollution (municipal, industrial, livestock operations).

- Accompanying measures include actions which are prerequisite for the investments or support a sound environmental development in other ways. These are represented by a wide range of activities like legislation, regulations, institutional strengthening, management programmes, research, education and measures to increase public awareness.

In the process of screening out priority projects, consideration has been given to a number of factors, such as

- The size of the polluter. Only the biggest point sources of pollution have been analyzed.

- The cost-effectiveness of the action. Analysis of cost-effectiveness regarding reduction of BOD, nitrogen and phosphorus has been undertaken.

- The effect of pollution. Although there is no generally accepted balance between different types of environmental problems, a judgement has been made based on all information collected during the study.

The relative impact on four water divisions in the study from actions in key places are given in table E3 below.

Table E3 RELATIVE IMPACT OF ACTIONS IN KEY PLACES

Key places	Issue	Rate of impact +++ = high, 0 = none			
		Vistula Basin	Coastal Rivers and Vistula Lagoon	Coastal Waters and Bay of Gdansk	Baltic Sea
Agriculture in Northern Poland	Reduction of pollution from livestock	0	++	++	+++
Coastal point sources	Municipal and industrial WWTP	0	++	+++	+++
Point sources in Lower and Middle Vistula Regions	Municipal and industrial WWTP	++	0	+	++
Point sources in Upper Vistula Region incl. Belarus and Ukraine	Municipal and industrial WWTP	+++	0	0	+
Mines in Upper Vistula Region incl. Ukraine	Reduction of saline discharge	+++	0	0	0

Two perspectives have been used to evaluate the cost-effectiveness: 1) Benefit to the Baltic Sea, and 2) benefit to the population and environment directly affected by pollution discharges (local benefit). Improvement in Baltic Sea conditions was the primary motivation for the HELCOM-coordinated pre-feasibility studies, but realistic conclusions must take into account the pressing health concerns, environmental damage and economic situation in the areas where the pollution originates. Most possible actions benefit both the Baltic Sea and the local environment, but the priority ranking based on cost-effectiveness may differ. For example, wastewater treatment plants in southern Poland improve river water quality in central Poland where it is needed for water supply but have less direct benefit to the distant Baltic Sea. The recommended Priority Investment Programme is developed from a dual ranking, and is described in Part 3 of this summary.

It should also be noted that the same type of measures which are needed for protection of the local environment must be introduced as a first step in reducing the substances threatening the Baltic Sea.

2.2 The Local Environment Reacts First

Due to the time required for the implementation of actions, the goal to have actions in full operation by the year 1995 is not reachable. Reversing the direction of development of the environment will take a decade or more. However, some actions will provide early response, at least for the immediate surroundings of the polluter. It is recommended that actions aiming at both long-term effects and immediate short-term effects should be initiated as soon as possible. In the calculations, we have anticipated that the Priority Action Programme will be in full operation by the year 2000 and that implementation of all proposed actions will take 20 years.

Special attention should be given to completion of certain facilities under construction which have stopped due to lack of funds. Restart of these projects can give quick results for low extra investment cost. In many cases only some engineering and mechanical equipment is missing. A list of 19 wastewater treatment plants in the Polish part of the Study Area which are more than 70% complete shows that plants for treatment totalling 745,000 m^3/day (approx $2.7 \cdot 10^6$ population equivalents) can be completed for $47.3 \cdot 10^6$ ECU. There are also examples of similar cases in the Belaric and Ukrainian parts.

2.3 Measures for Pollution Control

2.31 Water Conservation and Management

The increasing pollution of river water and groundwater has made it difficult to find sources for water supply near the consumers and arrangements for long distance transfer of water have been necessitated. This requires high investments

in pipelines. In many cases, this money could have been better used for investment in pollution abatement measures to keep the natural water quality sufficiently good for water supply.

The fact that an upstream polluter can be harmful to a series of downstream water supplies makes obvious the necessity for regional planning leading to an effective water conservation and management programme.

2.32 Municipal Wastewater Treatment

The basic goal should be mechanical-biological or mechanical-chemical treatment of all urban wastewater. Both methods considerably reduce BOD, suspended solids, and pathogenic organisms.

Given the current economic situation in the basin, efforts should be directed to reach these goals through phased programmes of incremental investment in treatment which, in the long-term, will allow these goals to be reached.

Before biological treatment can be started, a restoration programme for the collection areas to all municipal treatment plants must be carried out. Special attention should be given to industrial load, condition of sewer network, storm-water and water consumption.

2.33 Industrial Measures

All major polluting industries should take steps to meet pollution limits accepted in other European countries. The guidelines from the European Community are recommended for use and the established requirements should be considered by the management of each industry. In most cases, internal steps of reconstruction, process modifications, etc. ought to be taken. It is likely that this type of action should be combined with process modifications undertaken for making the whole production more rational and profitable. External treatment measures, including required pre-treatment before connection to a municipal treatment plant, should usually be preceded by internal measures.

The improvements are sometimes expensive to obtain in existing plants and they should be given reasonable time for implementing actions to meet proper environmental protection standards.

At all changes in process technology, type and quantity of production and ownership, the proper environmental protection measures have to be considered as a responsibility attached to the company.

2.34 Agriculture

The main threats to the environment from agriculture are

- Point discharge of manure from big farms causing damage of groundwater and oxygen deficit and bacteria concentrations in small rivers and transport of nutrients to the Baltic Sea.

- Non-point discharge of nutrients which can cause damage of groundwater and eutrophication in lakes and rivers or will be transported by air or water to the Baltic Sea.

- Discharge of pesticides and herbicides damaging groundwater and biological life in lakes, rivers, and in the Baltic Sea.

Of the 142,000 km^2 of agricultural land in the study area, 73 percent is occupied by small, privately-owned Polish farms, with an average size of 5 ha and livestock of about 4 animal units. These small production units, combined with low nitrogen-fertilizer application, presently have low nitrogen discharge to the water system. Only minor reductions of the discharge from these sources will be possible. Large Polish state farms represent 15% of the agricultural area and have an average size of 3000 ha with about 2000 animal units. Nitrogen discharge from these large farms can be reduced by 50 to 60 percent through manure storage and seasonally-timed applications. The remaining 12% of the agricultural area is mostly state-owned farms in Belarus and Ukraine which are even larger than the Polish state farms. On such large farms, reduction of the nitrogen discharge by 60 to 70 percent will be possible through changes in animal production and manure handling.

It will be possible to reduce the present nitrogen load on the Baltic Sea from agriculture by a total of about 25 percent through construction of 8-month manure storage tanks on larger farms (more than 30 animals), timing of manure application, use of cover crops and field plans, reduction of N-evaporation from fertilizer, regulation of draining, and conversion of the poorest arable land to forest plantation. The local benefits to river water quality would be significant in areas with severe agricultural discharges at present. However, the reduction assumes no changes in fertilizer consumption, land use or other farm practices, which is not likely to happen.

Present agricultural yields are low in the study area. The most obvious causes for low productivity are the low fertilization level, poor drainage, acid soils and the large number of very small farms. The grain yield has increased by 30 percent during the last decade to 3 tons/ha and it is estimated to increase further to 4.5 tons/ha during the next decade. This will require a doubling of the nitrogen fertilizer consumption and is likely to be accompanied by increased animal production. It is estimated that this will result in a doubling of the present nitrogen load on the Baltic Sea to 125,000 tons nitrogen per year. With

the previously mentioned reduction measures, this load will be reduced to 78,000 tons/year, which is 125% of the present level.

Increased fertilizer and pesticide prices or taxes, coupled with a per-hectare tax-refund arrangement can help restrain the increase in fertilizer and pesticides, and promote efficient use. Expansion of agricultural extension and consulting services to promote environmentally-sound farm practices will also help. True ecological or "organic" farming (no commercial fertilizer or pesticides) could stabilize nitrogen discharges from farms at a slightly lower level, but with lower yields as well. This would require a market for ecological farm products with a sufficient price premium to offset the lower net-productivity of ecological farming. International perceptions of pollution and soil contamination in Poland would likely hinder establishment of this market. The outlook remains that the HELCOM goal of a 50 percent reduction in pollution load is unrealistic for agriculture in the study area.

2.35 Wetlands

Wetlands and coastal lagoons include a wide range of biotopes at the interface between land and water. They are essential landscape elements with an important role in maintaining the biodiversity and they are valuable for protection of the Baltic Sea. By retention and slow discharging of rainwater runoff, wetlands equalize river flow, which facilitates self-purification and increases river water quality. Under favourable conditions, they reduce nutrients, especially nitrogen from non-point sources. At the same time, they are natural resources which are sensitive to overloading by nutrients and influence of toxic substances.

For these reasons, it is recommended to preserve existing wetlands and, if possible, to restore damaged wetlands. It is recommended to keep or establish protective zones consisting of wetland strips to intercept the drainage water from fertilized fields before it enters ditches or streams.

Discharging wastewater into natural wetlands or coastal lagoons is often considered as a case of environmental pollution. As there is an increasing interest to protect wetlands for their biological values, their use for wastewater treatment should be restricted. It is of great importance to design also constructed wetlands so that they obtain the same biological values as natural wetlands regarding flora and fauna and the shape of the landscape. As well-designed constructed wetlands need large areas, they are more suitable to use for small to medium size communities.

2.36 Salinity in Rivers

Actions need to be taken to reduce the discharge of highly saline waters to the upper Vistula and Bug from coal mining operations and the discharge of chlorides and sulphates from sulphur mining to the middle Vistula and San from sulphur mining operations. These discharges make the river water unpalatable and corrosive which creates additional needs for investments to supply water for drinking, industrial processes and cooling. Presently, the alternatives for the reduction of these discharges from the coal and sulphur mines are under investigation in the context of the restructuring of these industries. Due to the interlinkage between the restructuring process and environmental improvements in these industries, it is premature to recommend specific investment actions for this problem.

2.37 Air Pollution

Specific measures for control of air pollution from major industries and power plants, vehicles, district heating and agriculture are recommended in this study. There are a large number of nationally and internationally financed projects and government initiatives for control of air pollution in the study are, including power generation, industrial pollution control, district heating and energy conservation, and transportation. Proposed measures must be closely coordinated with these other programmes.

Actions are proposed to modernize industrial processes and production at several industries to reduce water pollution. These additional benefits are not estimated. For power plants, investment cost-effectiveness is evaluated for a single plant (Warsaw Siekierki) as an example. This project is included in the Baltic Sea programme, but may also be included under other regional investment programmes.

For vehicles, catalytic converters and unleaded gasoline should be required on all new vehicles beginning 1993 or 1994. The maximum lead-content of leaded gasoline should be reduced to 0.15 g/l, and unleaded gasoline made to cost no more than leaded gasoline. Emission controls and lower-sulphur fuel should be introduced on diesel vehicles and a timetable established to meet all vehicle emissions regulations of the European Community. Special efforts should be taken to maintain and enhance the viability of public mass transit and goods transportation in the coming decades, to ease the demand for private vehicles. An inspection programme for all vehicles should be established, and urban air quality monitoring enhanced to demonstrate the vehicle-related problems and progress to the public. Activities concerning the transportation sector should be coordinated with an initiative of the Baltic Ministers of Transportation.

A general programme of district heating renovation and energy conservation is recommended. This is not included in the priority action plan because the payback from energy savings enables this action to be handled as a loan program, and this is already under way in a major programme in Poland.

Agricultural recommendations, including manure storage tanks, fertilizer changes, improved field practices and other measures will reduce ammonia emissions to the air in addition to reducing surface water and groundwater pollution. These emission reductions have been estimated and are incorporated in the cost-effectiveness analysis.

2.4 Actions Primarily for Protection of the Baltic Sea

2.41 Nutrients

The handling of manure in agriculture in the northern part of Poland must be carefully considered. There have to be structural changes in order to ensure effective use of manure as natural fertilizer for crops. In order to avoid spreading of manure outside the growing season, storage tanks with 8 month capacity must be introduced on medium and large farms. Cover crops, liming, field plans, regulation of draining activities and preservation/creation of protection zones should also be arranged.

Actions have to be taken against the future rise of fertilizer use which threatens to increase the nitrogen discharge to the Baltic Sea. Regulation of the price of fertilizers and plans for application have to be used.

Nutrient reduction has to be installed in municipal wastewater treatment plants and for the industries in the middle and northern part of the area.

The target of 50 percent reduction from the 1987 emission levels is very difficult to achieve for nitrogen. The reduction of municipal sources by 50 percent requires that 3/4 of the population in towns and villages get high-efficiency nitrogen reduction and measures in all industries discharging nitrogen. Atmospheric emissions of NO_x could be reduced by 10 to 15 percent, but hardly more without enormous cost.

The major part of phosphorus emanates from municipal sources. Phosphorus reduction in municipal treatment plants combined with phosphorus reduction associated with the actions proposed for nitrogen reduction in agriculture, will enable the 50 percent goal to be reached.

2.42 Heavy Metals

A comprehensive programme against uncontrolled emissions of heavy metals must be initiated within the wastewater collection area for all wastewater treatment plants (WWTPs) included in the Baltic Sea Programme. Metal contamination of municipal wastewater disturbs biological treatment processes and renders the sludge unsuitable for spreading on farmland. Measures against metal emissions have to be taken at polluting industries of all sizes, not only the major ones. The use of unleaded gasoline should be promoted, and the lead content reduced to 0.15 g/l in leaded gasoline.

2.43 Persistent Organic Substances

A programme for considerable reduction of discharges of persistent organic substances should be carried out for all projects in the Baltic Sea Programme. The programme would focus on pulp and paper industry, organic chemicals industry, waste incineration and other sources of persistent organic substances.

Restriction has to be put on the use of herbicides and pesticides.

2.5 Accompanying Measures

2.51 Background

Sound development of environmental protection, including the proposed priority action programme, can be difficult to fulfil for an already strained economy and requires personal motivation and engagement. The general public has to be involved and encouraged in efforts to improve the environmental aspects of all activities.

The governments in the Study Area are concerned about the environmental status, and a number of legislative and administrative actions against environmental pollution have been taken. Scientists, non-governmental organizations as well as individuals are also engaged in solving the problems.

The actions already taken are commendable and deserve support. This report includes recommendations for continued development of non-investment measures crucial to the feasibility and cost-effectiveness of the investment programmes. Some of these measures will be required by international financing institutions as conditions of investments. Examples are given for Poland, but are valid as general recommendations for the entire Study Area.

2.52 Policy, Legislation and Administration

It is recommended that the proposed Polish National Environment Policy be passed by the Parliament. This new law will make it easier for environmental authorities to follow a unified strategy and it will support the general acceptance of environmental protection measures.

A reconstruction of legislation is going on in Poland and the recommendations mostly concern the effective implementation. It is recommended to link the changes in the legislation for Spatial Planning and changes in the regulations for building and site permissions closely to the Environmental Protection Act and the Water Law. In particular, the building and site permit process should include environmental review and clear definition of environmental responsibilities and restrictions.

A central Environmental Protection Agency is recommended with responsibility to formulate the regulations and practices for regional offices, and to coordinate with non-governmental organizations and other groups on a national level.

It is also recommended to establish an effective appeal system for environmental decisions, both within the administrative system and the ordinary court system, to ensure democratic control.

The permit granting system must be improved for enterprises actively influencing the environment. It is recommended that pre-assessments be compulsory when the enterprises change or increase their production. In existing production, time limits for permits have to be established. A system with targets for gradual strengthening of the requirements for permits is recommended for speeding up the technical development. The fulfilment of the conditions for the permits has to be subject to regular environmental audits.

To conserve water resources and to decrease the volume of wastewater discharged for collection, treatment and disposal, activities are encouraged to rationalize water consumption by agricultural, industrial and municipal users. These activities include reform of the process for setting water charges and increasing user charges for water and wastewater, implementation of effective metering and billing systems, water conservation studies for key users, and public education activities. A decrease in domestic and industrial wastewater will permit effective expansion of the capacity of existing treatment plants, and possible reductions in the size and costs for proposed treatment plants.

2.53 Economic Instruments

The following initiatives are recommended to improve and extend the existing system of economic instruments in Poland:

1. Adjustments of the level of charges for different pollutants within the present system of emission charges and fees.
2. It is recommended to evaluate the use of tradable permits in special cases, primarily on an experimental basis.
3. It should be considered to introduce a charge on fertilizers in Poland in order to limit the foreseen increase of their use. It should also be considered to impose a charge on pesticides as an intermediate action.
4. Each user should pay the relevant expenses for both supply of water and treatment of wastewater, and fees must cover the real continuing costs of operation and maintenance.
5. Economic support in the form of subsidies to technical development, i.e. technical research, pilot plants and demonstration plants is recommended.
6. It is recommended that the entire energy sector should have a coherent system of charges and support in order to reduce energy consumption and to promote change to clean technology.

2.54 Monitoring

The existing monitoring of river and coastal waters has provided valuable information on the surface water quality conditions. The ongoing improvement of the monitoring system is appreciated, and further improvement is recommended.

It is important that the monitoring programme be problem-oriented. Too extensive sampling should be avoided and the selection of relevant parameters should be considered carefully. It is also essential that acts to combat pollution are based upon analysis of cause and effects.

It is essential that the sampling and laboratory analyses are reliable and validated by cross-checks and inter-calibrations. An increase of the capacity and quality of laboratories is proposed. Analyses should be collected in data banks available for statistical and other work. Efforts should be directed to organization, presentation and dissemination of available data to promote public awareness.

2.55 Product Control

Monitoring of production procedures, chemical consumption, treatment processes, effluent quality, and disposal of waste, along with monitoring of receiving waters, air and soil, produces essential information for factory management and for the environmental authorities.

2.56 Cooperation

Initiatives for regional cooperation, cooperation between and within sectors of society and international cooperation are to be encouraged. The implementation of the action programme requires an industry of good quality and ability to supply the needed structures and equipment.

2.57 Applied Research

We recommend promotion of applied research and permanent education possibilities in the fields of implementation and operation of environmental protection activities such as treatment plants.

2.58 Public Awareness and Education

The public knowledge and awareness of the environmental assets should be promoted by activities in schools and in media. Activities by non-government organizations (NGOs) usually have good informative effect.

3 INVESTMENT PROGRAMMES

For the point sources within hot spots, reliable cost estimates for a defined reduction of BOD, nitrogen and phosphorus can be assessed. These have been screened according to cost-effectiveness for reduction of nutrients and the most efficient ones are selected for the Baltic Sea Protection Programme. Due to lack of reliable data for heavy metals and persistent organic substances, cost-effectiveness analysis is not possible for these substances. Instead estimated risk of emission of hazardous substances in certain industrial processes has been used for selection of the priority projects. This Baltic Sea action programme is presented in section 3.1.

The local threat of pollution is of great concern for the authorities in the countries covered by the Study. We have made an additional selection of priority projects from the local environmental perspective. The water supplies of Warsaw and Plock and in the Krakow and Katowice areas constitute the most severe local pollution problem. This programme for local benefits is presented in section 3.2.

The Priority Action Programme which combines the Baltic Sea and local rankings is presented in section 3.3.

For comparison, an assessment is presented in section 3.4 for the case if all proposed actions were implemented. The benefits of these recommended investment actions are presented in section 4.

3.1 Baltic Sea Protection Programme

	Investment 10^6 ECU	Total annual cost 1) 10^6 ECU/year
Manure tanks for major animal farms	1,330	110
Municipal WWTP, 9 projects 2)	730	123
Industrial abatement measures, 5 projects 3)	20	6
Heat and power plant, 1 project 4)		1
Total	2,080	240

1) Operation and maintenance costs plus interest and repayment of the investment costs.

2) Koszalin, Gdansk Wschod, Gdynia, Bydgoszcz, Torun, Wloclawek, Warsaw Czajka, Lublin and Tarnow.

3) Swiecie pulp and paper, Boruta organic chemicals, Jaworzna nitrogen and organic chemicals, Oswiechim chemicals and Boleslaw Bukowna metal works. Note that the figures are usually only for pre-treatment. Final treatment takes place in a municipal plant.

4) Warsaw Siekierki Plant.

3.2 Special Programme for Improvement of the Surface Water Supply Resources for Katowice, Krakow, Warsaw and Plock

	Investment 10^6 ECU	Total annual cost 10^6 ECU/year
Desalination for the most saline wastes	620[1)]	135[1)]
Municipal WWTP	780[2)]	153[2)]
Industrial measures	45	12
Total	1,445[1) 2)]	300[1) 2)]

1) If methods under development i.e. deep well injection prove to be successful, the costs can be considerably reduced.

2) Requirements for pretreatment in medium and minor industries are not investigated in Katowice region and the cost for pretreatment is not included.

3.3 Priority Investment Programme

The two cost-effective ranking lists have been synthesized and compiled with other aspects of priority, such as the magnitude of existing very serious environmental problems that can be reduced and the time and administrative opportunity to fulfil the investment. This operation is a judgement based on all information collected during the study. Actions classified as priority 1 have the best opportunity to give considerable result in sensitive areas as soon as possible. See table E4 below.

3.4 All Proposed Actions

These costs are computed totals of the actions for major polluters selected for investigation in the study. The municipal actions cover a population of 7.5 million out of the total population of 26.7 million in the Study Area. The industrial projects represent an even smaller part of the total number of industries. This indicates that the total requirement of investment in environmental protection actions in the Study Area is several times higher.

	Investment 10^6 ECU	Total annual cost 10^6 ECU/year
Desalination for the most saline wastes	620[1)]	140[1)]
Municipal WWTP 28 projects	1,800	310
Industrial measures	100	20
Agriculture	1,330	110
Total	3,850[1)]	580[1)]

1) If methods under development for reduction of salt discharge from mines, i.e. deep well injection, prove to be successful, the costs can be considerably reduced.

Financial Methods, Economic Terms and Parameters

Cost-effectiveness analysis compares the amount of pollution reduction to the cost of a project, giving a ratio of cost per reduced kilogram of pollutant.

A comparable annual cost for each project is computed as the sum of the annualized investment cost plus annual operation and maintenance costs.

Annualized investment costs = Investment costs x a, where 'a' (the annualization factor) is defined as:

$$a = \frac{r}{1 - [1/(1 + r)^T]}$$

r is the real interest rate and T is the lifetime of capital. The factor 'a' is used to spread the investment costs over the lifetime of equipment and constructions. The annualized investment costs may be interpreted as the interest and repayment of a loan obtained to finance the investment costs.

Real interest rate: $r = \frac{1 + n}{1 + i}$, where

n = nominal interest rate
i = inflation rate

Throughout the report, it is assumed that r = 7 per cent.

Lifetime of constructions and equipment: T

Municipal wastewater treatment plants (WWTP)

- Equipment: T = 10 years
- Construction: T = 30 years

Industrial wastewater treatment

- All investment costs: T = 10 years

Agricultural investments

- Manure disposal tanks: T = 30 years

Table E4 PRIORITY INVESTMENT PROGRAMME

Priority	Location	Country	RUME Site	TYPE	Total Investment Costs Total 10^6 · ECU	Investment Costs Foreign 10^6 · ECU	Investment Costs Local 10^6 · ECU	Operation Cost 10^6 · ECU/year
1	Baltic Coast	Poland	Agriculture/ Livestock	Agricultural Runoff Programme	1,330.0	150.0	1,180.0	0[1]
1*)	Baltic Coast	Poland	Koszalin	Municipal & Industrial	44.2	12.2	32.0	2.5
1*)	Baltic Coast	Poland	Gdansk-Wschod	Municipal & Industrial	101.1	29.0	72.1	7.3
1*)	Baltic Coast	Poland	Gdynia-Debogorze	Municipal & Industrial	57.8	17.0	40.8	4.1
1	Vistula	Poland	Bydgoszcz	Municipal & Industrial (Chemical)	161.0	49.0	112.0	7.1
1	Vistula	Poland	Torun	Municipal & Industrial	95.0	27.7	67.3	4.3
1*)	Vistula	Poland	Wloclawek	Municipal & Industrial	33.3	10.1	23.2	1.4
1*)	Vistula	Poland	Warsaw-Siekierki	Municipal & Industrial	119.0	36.0	83.0	5.6
1	Vistula	Poland	Tarnow	Mineipal & Industrial	106.0	34.0	72.0	6.0
1	Vistula	Poland	Krakow-Plaszow	Municipal & Industrial	91.0	31.0	60.0	7.6
1	Vistula	Poland	Krakow-Kujawy	Municipal & Industrial	100.0	31.0	69.0	5.4
1	Vistula	Poland	Katowice-East	Municipal & Industrial	147.0	52.0	95.0	23.0
1	Vistula-Bug	Ukraine	Lvov	Municipal & Industrial	214.0	81.0	133.0	6.5
Total Priority 1					2599.4	529.0	2070.4	80.6
2	Vistula	Poland	Swiecie	Industry (Pulp & Paper)	13.0	5.7	7.3	1.3
2	Vistula	Poland	Warsaw-Czajka	Municipal & Industrial	76.0	21.0	55.0	4.7
2	Vistula	Poland	Warsaw-Pancerz	Municipal & Industrial	232.0	75.0	157.0	11.6
2	Vistula	Poland	Lublin-Majdow	Municipal & Industrial	46.0	18.0	28.0	7.0
2	Vistula	Poland	Jaworzno Organics Azot	Industry (Chemical)	1.7	0.6	1.1	0.1
2	Vistula	Poland	Zgierz-Boruta Pyrotuffs	Industry (Chemical)	3.5	1.4	2.1	0.3
2	Vistula	Poland	Oswiecim-ZCHO Chem.	Industry (Chemical)	16.5	6.6	9.9	0
2	Vistula	Poland	Zaklady Cornelco	Industry (Metals)	7.0	2.8	4.2	1.0
2	Vistula-Bug	Belarus	Brest	Municipal & Industrial	40.0	12.0	28.0	4.2
2	Vistula	Poland	Upper Basin	Salt Control	620.0	248.0	372.0	135
Total Priority 2					1055.7	391.0	674.6	165.2
Total Priority 1 and Priority 2					3625.1	920.1	2684.0	245.8

1) A decrease in annual expenses for fertilizer is likely

*) These projects can be implemented relatively quickly

BTB40.asc/VU0/920904.DSR

4 BENEFITS

4.1 The Baltic Sea Protection Programme

Table E5 BENEFITS OF THE BALTIC SEA PROTECTION PROGRAMME

Calculated reduction if all actions in the Baltic Sea programme described in section 3.1 were in effect by the year 2000.

Source:	BOD_5	Nitrogen	Phos-phorus	Toxic metals	Toxic organic substances
Point sources	37 kt	8.9 kt	1.7 kt	high	high
Agriculture	-	17 kt	-	-	-
Atmospheric dep.	-	0.1 kt	-	-	-
Total reduction	37 kt	26 kt	1.7 kt	high	high
Reduction in % of 1987/1990 emissions to the Baltic Sea	10-15%	No reduction but increase is limited to 30% instead of 50%	10%	unknown	unknown

kt means thousand tons/year

It can, hence, be concluded that the Baltic Sea Protection Programme is not sufficient to reach the goal of a 50 percent reduction in pollutants emission to the Baltic Sea.

The water quality in the vicinity of Gdynia, Gdansk, Swiecie, Torun, and in Lake Jamno will improve considerably.

4.2 Special Programme for Improvement of the Surface Water Supply Resources for Katowice, Krakow, Warsaw and Plock

There will be a 50 percent reduction of salinity in the Vistula from Katowice to Warsaw. The disadvantage of corrosion and bad taste will be considerably reduced.

A substantial part of the Vistula water will improve in quality to the extent that it will be more usable, i.e. for recreational purposes, fishing, etc.

4.3 Priority Investment Programme

4.31 Actions

The priority investment programme is a combination of the Baltic Sea priority programme, the water supply in Upper and Middle Vistula programme and the proposed actions for Brest in Belarus and Lvov in Ukraine. The programme has two classes of priority, see Table E4.

The benefits from the actions in the programme shown from the perspectives are;

- The Baltic Sea
- The Coastal Area
- The Vistula Catchment Basin
- The Damages by Salinity in Upper Vistula Region

4.32 The Baltic Sea

Tables E6 and E7 show the discharge and reduction in BOD, N and P if the priority investment programme, priority 1 and 2, would be implemented.

The reduction of nitrogen is less than the anticipated increase mainly caused by a rise in fertilizer use in agriculture, hence, the increase of load instead of reduction. Reduction of BOD and phosphorus is only a part of the 50 per cent reduction goal.

The investment programme has also taken actions for reduction of heavy metals and persistent organic substances. The amounts have not been calculated due to lack of basic analyses.

Table E6 DISCHARGE AND CALCULATED REDUCTION OF PRIORITY INVESTMENT PROGRAMME PRIORITY 1, BALTIC SEA PERSPECTIVE

	Discharge tons/year		Reduction	
	1987/90	2000	tons/year	percent
BOD_5	196,000	169,000	41,000	14
N	143,000	186,000	26,000	-30
P	9,700	8,600	1,700	11

Table E7 DISCHARGE AND CALCULATED REDUCTION OF PRIORITY INVESTMENT PROGRAMME PRIORITY 1 and 2, BALTIC SEA PERSPECTIVE

	Discharge tons/year		Reduction	
	1987/90	2000	tons/year	percent
BOD_5	196,000	159,000	51,000	14
N	143,000	183,000	29,000	-28
P	9,700	8,200	2,100	15

4.33 The Coastal Area

(a) The Gulf of Gdansk

The coastal waters in the Gulf of Gdansk suffer from poor water quality. The pollution by direct discharge of wastewater from the population and industries in the Gdansk-Gdynia region together with the polluted Vistula river discharge constitutes a severe load on the marine environment.

It is likely to assess that the water quality and sanitary conditions in the vicinity of Gdansk and Gdynia will improve significantly when the priority investment programme is in effect.

The conditions in other parts of the Gulf of Gdansk are mainly controlled by the pollution from the Vistula river and the open exchange of water with the Baltic Sea. These conditions will not change significantly. The reduction of BOD and phosphorus will balance with the increase in other parts. Nitrogen will show a total increase due to the rise in fertilizer use in agriculture. The large phytoplankton production will most likely increase.

The calculated reduction of BOD_5-load from Gdansk and Gdynia is 16,300 tons/year.

(b) The Open Coastline, the Vistula Lagoon and the Coastal Rivers

A great number of the major farms are situated in the coastal area. When the actions proposed for manure-handling are in operation, a considerable improvement of the water quality in coastal rivers and along the coastline can be expected.

4.34 The Vistula Catchment Basin

The totals of the calculated local reductions of BOD_5 discharge within the Vistula catchment basin is 142,000 tons/year. It can also be expressed as the result of secondary treatment for 7 million population equivalents.

The benefit of the municipal and industrial actions programmes is not only that of improved oxygen concentration at and downstream the discharge point of each source of pollution but also a significant reduction of bacteria, viruses and metals.

Even if the reduction is only about 20 per cent of the total load on the basin, the actions are made for the largest pollution concentrations and the water quality in the rivers will improve locally. In several parts where the pollution now hampers all use of the water, the improvement will make river sectors usable for fishing, irrigation and recreation.

4.35 The Damages by Salinity in Upper Vistula Region

The priority investment programme includes actions against discharge of saline water from drainage of coal mines in the Katowice region. The reduction of chloride (usually in the form of sodium chloride) is estimated at $1.3 \cdot 10^6$ tons/year. This will give a reduction of salinity in the Vistula and its headwaters sufficient for significant reduction of corrosion problems in industrial and municipal use of water in the Katowice region. It will also reduce the unpalatable taste of the drinking water in Warsaw.

4.4 All Proposed Actions

When major towns and industries have been furnished with proper wastewater treatment, river water quality will be restored from the out-of-class situation for most parts of the river, which means that the river water at least can be used for some industrial and recreational purposes.

COMMISSION OF THE EUROPEAN COMMUNITIES

DIRECTORATE - GENERAL
ENVIRONMENT, NUCLEAR SAFETY
AND CIVIL PROTECTION
DIVISION XI - C-2

EUROPEAN INVESTMENT BANK

PREFEASIBILITY STUDY OF THE ODER/ODRA RIVER BASIN

COMPONENT OF THE BALTIC SEA ENVIRONMENT PROGRAMME

SYNTHESIS REPORT

BCEOM, French Engineering Consultants

with : SAGE SERVICES FRANCE
SOGREAH FRANCE
IMGW POLAND
PROSAN POLAND
LAHMEYER International GERMANY
T.G.M. WRI CZECHOSLOVAKIA

APRIL 1992

Executive Summary

The Oder basin, Current situation, Sources of pollution

The aim of the present pre-feasibility study covering the entire Oder/Odra river basin is to prepare in the context of HELCOM a priority action programme to control and reduce the present pollution level of the Baltic Sea. In line with the Baltic Sea Environmental Declaration of September 3, 1990, its aim is to recommend measures to reduce pollutant emissions by 50% in the three countries in question (Poland, Germany and Czechoslovakia) by 1995 when compared with 1987 levels.

To this end, a study contract, financed by the Commission of European Communities (CEC) and supervised by the European Investment Bank (EIB), was signed with BCEOM on July 17, 1991. BCEOM has worked on the study in association with two other French consultants, two institutions in Poland and an institution from each of the other two countries. The draft form of the present report was submitted on February 14, 1992.

The main characteristics of the Oder basin, which covers 119,000 km2, are summarised in table 1.S below and illustrated by figure 1. Although the Oder extends into Czechoslovakia and Germany, the major part of the basin is located in Poland where it also has a major right bank tributary, the Warta river, which is as long as the Oder river itself. The Oder river and another tributary, the Nysa Luzycka, form the border between Poland and Germany over a 350 km distance.

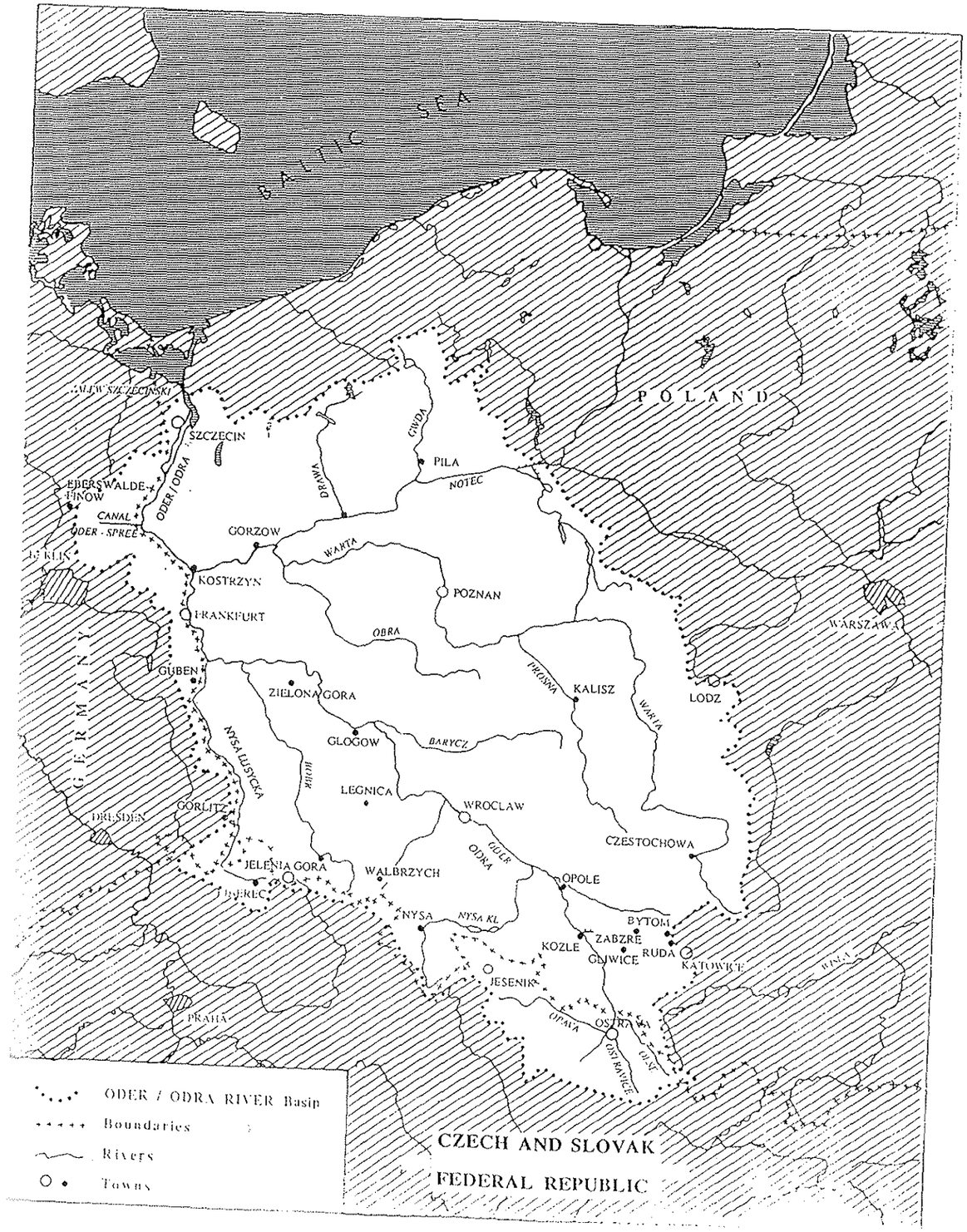
Table 1.S ([1]) Characteristics of Oder basin

	in Poland	in Czechoslovakia	in Germany	Total
Area - km2	106,000	6,500	6,500	119,000
- %	89.0	5.5	5.5	100
Length of Oder course (km)	762	92	170 ([2])	854
Population - Million	13.0	1.4	0.9	15.3
- %	85	9	6	100
Cities above 100,000 inhabitants :				
- number	19	2	0	21
- Population	5,017,000	435,000	0	5,452,000
- %	92	8	0	100
Main polluting Industries				
- number	171	27	8	206
- %	83	13	4	100

[1] Tables included in the Executive Summary are designated by a figure followed by the letter S.

[2] border with Poland

THE ODER / ODRA RIVER BASIN



The contributions made by the different sources of Pollution in terms of total pollutant loads discharged into the Oder and its tributaries are evaluated in table 2. This table takes 1990 as its reference year rather than 1987 due to the poor quality of the data available for this latter year.

Table 2.S. Estimated loads of pollutants discharged in 1990 by the various sectors

Sector	CATEGORIES									
	BOD_5 [4] (toxic organic substances)		Nutrients				Heavy Metals		Chlorides and Sulphates	
			total Nitrogen		total Phosphorus					
	in 1,000 t/y	%	in 1,000 t/y	%	1000 t/y	%	in t/y	%	in 1,000 t/y	%
Industries, Mines,	32	13	7	6	1.0	7	1500	100	2630	100
Municipalities	210	87	48	42	12.9	86	-[3]	-	-	-
Agriculture/animal husbandry	-[3]	-	60	52	1.1	7	-	-	-	-
TOTAL	242	100	115	100	15.0	100	1500	100	2630	100

Together with the Vistula in Poland, the Oder basin represents one of the two most important sources of pollution of the Baltic Sea. This is essentially due to its high population level (15.3 million inhabitants) as well as the presence of large cities, mines and industrial complexes. Industrial development in the region, largely based on coal extraction, metallurgical (ferrous and non-ferrous) and chemical industries, is particularly concentrated in the upper part of the catchment areas in Silesia, Czechoslovakia and Poland. The result of this industrial activity is that a heavy load of pollutants is discharged into the upper Oder and its tributaries at a great distance from the Baltic Sea with a resultant heavy impact on the countries themselves. The upstreamareas of the Warta river are far less polluted, with the notable exception of the Czestochowa region.

Pollutants have been grouped into four different categories to assess their separate impacts on the Baltic Sea (first three categories) and within the countries themselves (all categories).

The first two categories, being toxic organic substances (measured through BOD5 [2] , and nutrients (nitrogen and phosphorous compounds), have been estimated by totalling individual discharges into the rivers at the points of pollution themselves. Quantities of the last two categories, being Heavy Metals and Salts, Chlorides and Sulphates have been estimated by water quality measurements taken directly from the rivers. These are probably underestimated as, for example, Heavy Metals are deposited all along the river courses.

3 Impossible to assess without more detailed studies.

4 BOD5 : Biological Oxygen Demand measured over 5 days.

Total pollutant load discharges into the Baltic Sea are difficult to estimate due to the existence of a large 700 km2 lagoon downstream from Szczecin (Stettiner Haff/Zalew Szczecinski). Loads entering into the lagoon are estimated through water quality evaluations. Table 3 below gives an analysis of the pollutant contents.

Table 3.S. 1990 pollutant loads in the Oder river at the mouth of the SZCZECIN Lagoon (t/y)

BOD_5	56,300
Nutrients:	
Total Nitrogen	24,000 [5]
Total Phosphorus	6,600 [5]
Heavy Metals	530 (Zn:386;Cu:86;Pb:49;Cd:9)[5]
Salts:	
Chlorides	1,700,000
Sulphates	938,000

Comparisons made between tables 2 and 3 demonstrate the high level of self-purification occuring along the river course. Less than one fourth of organic substances and nitrogen and lessthan half the phosphorous discharged along the length of the river are detected at the mouth of the Lagoon. The decrease in the concentration of Heavy Metals downstream is explained by the depositsmade along the course of the river which can represent up to 40% of the actual discharges. Chlorides and sulphates are neither deposited nor transformed.

A water quality model has been developed to assess these phenomena and to examine what measures could be taken to reduce the qualtity of pollutants reaching the lagoon downstream from Szczecin. The model has demonstrated that the Baltic Sea protection measures should concentrate on municipalities and industries located in the downstream region of the Oder basin wether measures should be taken to limit local pollutant impact in the upstream regions (see below).

5 As direct assessment is not possible for these components, estimates have been made by measurements taken at km 690 and at the mouth of the Lagoon at km 762, comparing :

- total nitrogen and ammonia plus nitrates,
- total phosphorus and phosphates,

The same types of estimates have been used for Heavy Metals on the basis that they would show the same deposits as suspended solids, being 40 % of the loads measured at km 690. Zn = Zinc, Cu = Copper, Pb = Lead, Cd = Cadmium.

A further model will be required in the future to assess the pollution levels in the Lagoon and, consequently, the pollution loads being released into the Baltic Sea. Measurements, essentially related to physico and bio-chemical indices, were begun three years ago. Results for Heavy Metals are not yet available. The Lagoon acts as an excellent stabilisation and self-purification pond protecting the Baltic Sea, but this obviously has a fundamental effect on the Lagoon's ecological balance (excessive algae growth and Heavy Metal deposits probably being the most negative factors).

A "Hot Spot" approach was adopted to classify pollution sources. A Hot Spot can be defined as a heavy polluter or, more generally, a group of major industrial or municipally based pollution sources. This approach has proven its worth in identifying the main sources of pollution and making it possible to define a priority programme. However, in itself this approach alone cannot meet the pollution reduction aims as there are other minor point sources of pollution spread right across the catchment area which also need to be taken into account. It is also necessary to analyse other, more diffuse sources of pollution which have indirect consequences on the water quality, such as agriculture, cattle breeding and atmospheric pollution.

Among an initial selection of 15 potential Hot Spots, eight have been confirmed. This evaluation is based on a standard analysis of discharged pollutant loads, as described in the Synthesis Report. These are, in decreasing order of severity, as follows (all are in Poland, except Ostrava which is in Czechoslovakia):

1. Katowice area ([6])
2. Legnica - Glogow
3. Lodz
4. Ostrava
5. Szczecin
6. Wroclaw
7. Poznan
8. Zielona Gora

They are municipal and industrial Hot Spots, except for Lodz and Poznan (municipal pollution only), Zielona Gora (mainly municipal pollution with some agro-food industry discharges), and Legnica-Glogow (essentially industrial).

They contribute the following to the total pollutant loads discharged into the rivers by point pollution sources:

BOD5 = 54% Total N ([7]) = 60% Total heavy metals = 78%
Total P ([7]) = 60% Total Salinity = 45%

A priority programme addressing the impacts in the countries under consideration should first consider these particular Hot Spots and, in particular, the five hottest.

[6] includes the major cities of Ruda Slaska, Bytom, Zabzre and Gliwice.

[7] N : Nitrogen, P : Phosphorus

Proposed investment programme

Detrimental local impacts occur immediately downstream from the main municipal and industrial pollution sources located in the upper part of the Oder basin in Czechoslovakia and Poland. In view of these local impacts, a programme should be initiated to reduce the pollution caused by the three main upstream Hot Spots represented by Ostrava and Katowice near the Oder river and Lodz on a tributary of the Warta river.

In order to reduce local pollution impacts, most tangible through the quality of the drinking water, priority should be given to reducing BOD5, ammonia and heavy metals. As a result, the proposed programme includes waste water treatment plants in municipalities (effect on BOD5, nitrogen and its ammonia content) as well as in industrial facilities where they will have an impact on heavy metals as well as on BOD5 and ammonia. Municipal treatment plants will also play a major role in reducing bacteriological contamination, this being a major concern in all rivers.

The following has also been proposed:

- to diminish the phosphorous content (through municipal and industrial facilities), this in turn would reduce excessive algae growth, both in the rivers and in the Lagoon, and improve the quality of the drinking water,

- to decrease salinity by increasing releases from existing reservoirs when rivers reach a certain low level threshold.

In terms of analysing the impact of pollution on the Baltic Sea, the water quality model proved that priorities were not necessarily as expected, demonstrating that municipal and industrial sources of pollution in the lower part of the Oder basin should be given priority treatment. The loads discharged in the upstream Hot Spots of Ostrava, Katowice and Lodz are considered as being negligible by the time they reach the Baltic Sea (with the exception of heavy metals and salt content).

The following investment programmes successively analyse the impacts, both on a local level and in terms of the Baltic Sea.

Proposed programme for reducing pollution at a local level

This programme, summarised in table 4.S., aims at reducing point pollution sources by 50%, as required by the Terms of Reference (TOR).

Table 4.S Proposed programme for reducing pollution at a local level

COMPONENTS	Cost (Million ECU)	Pollution reduction (% of 1990 estimated loads)			
		BOD5	N	P	Heavy Metals[8]
MUNICIPALITIES (waste water treatment plants and sewage systems)					
Alt. 1 = Hot Spots [9]					
- without Tertiary Treatment Plants	800	41	14	16	n.a.
- with Tertiary Treatment Plants	877	41	29	34	n.a.
Alt. 2 = 23 CITIES [10]					
- without Tertiary Treatment Plants	1035	53	18	21	n.a.
- with Tertiary Treatment Plants	1160	53	37	44	n.a.
ALL MUNICIPALITIES	-	100	100	100	n.a.
INDUSTRIES [11]					
Reduction of heavy metals [12]	127	-	-	-	38
Reduction of BOD5	115	55	[13]	-	-
Reduction of N and P	24	-	53	40	-
Other impacts (Phenols)	54	-	[13]	-	-
TOTAL	320	55	53	40	38
ALL INDUSTRIES	-	100	100	100	100
TOTAL ALT. 1 (with Tertiary Treatment) + Industries	1197	43	32	34	38
TOTAL ALT. 2 (with Tertiary Treatment) + Industries	1480	53	39	44	38
ALL MUNICIPALITIES + INDUSTRIES	-	100	100	100	100

[8] Not presently available (n.a.), should be considered in the future after a more detailed assessment.

[9] Refers to Scenario 2 in Technical Report 2 on Municipalities.

[10] Refers to Scenario 3 in Technical Report 2 on Municipalities.

[11] List of concerned industries given in the Synthesis Report.

[12] Including reduction of atmospheric pollution.

[13] Also has some impact on N.

In the industrial sector, costs very rarely include process changes except where these cannot be separated from pollution reduction methods. However, it is believed that ongoing industrial restructuration will play a major role in reducing pollution.

Pollution caused by agricultural practices has already been reduced by 50% for nutrients (see below) and is not presented table 4 above.

This table demonstates that the aim of reducing N and P by 50% has not been achieved. To attain this figure, it would be necessary to build tertiary treatment plants in other 43 municipalities at a cost of 180 million ECU. This could be accomplished at a later point in time. In all the other cities included in the above scenarios, it is recommended that the building of tertiary treatment plants be delayed for a 5 year period (except in Ostrava), due to the technical difficulties associated with their installation (preliminary training, etc...) and their low cost/efficiency ratio.

In terms of non-point pollution sources in agriculture, discharges have been reduced by 50% over the last three years by a quick reduction in the consumption of fertilisers (and pesticides) due to their price increase. However, the future could see agriculture once again becoming a major contributor to nitrogen pollution. It is recommended that a research and education programme for rural extension advisors and farmers be set up in the near future to prevent any increases in pollution. Special attention should also be paid to pig farms as their local impact can be highly detrimental even though they only seem to represent a small percentage of organic substances and nitrogen downstream from their discharge points. However this needs to be confirmed by a more detailed assessment at a later stage, as probably these pig farms, and more generally animal husbandry may have a significant contribution to organic pollution through manure (bad storage and untimely spreading in the fields).

Atmospheric pollution has severe and direct detrimental effects on health. Its indirect effects on water quality, being the issue examined in this document, are noticeable in terms of Heavy Metals. Deposits of these metals on the land are estimated at 350 t/year in the Oder Basin, of which 60% is lead. Quantities of lead washed away by water are estimated to be of the same order of magnitude as direct discharges into the rivers by industry (60-70 t/year). A programme aiming to reduce atmospheric pollution cannot simply be limited to Heavy Metal emissions. The programme being studied covers 7 industries, costs around 700 million ECU and would substantially cut down SO2 and NOx pollution in addition to reducing dust and Heavy Metals (40% of the total for these last two components).

In terms of waterquality alone, priority must be given to reducing Heavy Metal emisions, especially by the copper industry in Glogow. Only this latter contributor is included in table 4 above. The necessary investment would amount to 100 million ECU.

Proposed programme for reducing pollution in the Baltic Sea

To consider the environmental impacts on the Baltic Sea, the programme has been optimised through the use of a water quality model. It demonstrates that :

- For municipalities:

It is possible to eliminate respectively 34 %, 25 % and 12 % of BOD5, N and P, originating from the municipalities through the installation of secondary and tertiary treatment plants in 13 municipalities. These municipalities, located in the central and downstream parts of the Oder basin do not include the Hot Spots of Ostrava, Katowice and Lodz.

- For industries:

(i) without further detailed studies, there is no alternative to the heavy metals programme proposed above, even though this would only have a limited impact downstream,

(ii) the BOD5 reduction programme also has a limited impact; it needs to focus on five industries, four of them in the downstream Oder region and one in the downstream Warta region,

(iii) a 50% load reduction of phosphorus discharged by industries is possible through measures focussing on the dump site near the town of Police (close to Szczecin).

Details and costs of the corresponding programmes are summarised in table 5.S.

Table 5.S. PROPOSED PROGRAMME TO REDUCE POLLUTION IN THE BALTIC SEA

A. Cost of the Programme

Components	Cost (Million ECU)
MUNICIPALITIES = WASTE WATER TREATMENT PLANTS INCLUDING TERTIARY TREATMENT [14]	550
INDUSTRIES	
- Reduction of Heavy Metals [15]	136
- Reduction of BOD5 [16]	37
- Reduction of P [17]	6
- Total	176
TOTAL MUNICIPALITIES (incl. Tertiary Treatment Plants) + INDUSTRIES	726

B. Reduction of Pollution [18]

Components	BOD5	N	P	Heavy Metals
MUNICIPALITIES, with waste water Treatment Plants including Tertiary Treatment	34	41	12	-
INDUSTRIES, with the above described components	1 [18]	negl.	3	12.5 [19]
TOTAL	35	41	15	12.5 [19]

14 Police, Szczecin, Gryfino, Pila, Naklo, Guben (Germany), Zielona Gora, Nowa Sol, Glogow, Leszno, Legnica, Wroclaw and Poznan.

15 8 industries, 7 in the Hot Spots of Ostrava, Legnica-Glogow and Szczecin, one in Czestockowa.

16 4 Paper mills, 1 sugar industry, of which two in the Szczecin, one in Czestockowa.

17 Police Dump Site near Szczecin.

18 The reductions of pollution are presented as a % of the total loads in 1990 at the mouth of the Lagoon. They were estimated through the water quality model. It is believed that this model underestimates the BOD5 reduction of the industrial programme and probably also the phosphorus reductions.

19 29 % for Lead only.

Recommended priority programme and Accompanying measures

Due to the severe local pollution impacts, it is recommended that the programme described in table 4.S above concerning regional impacts be adopted alongside the construction of waste water treatment plants in the 3 other municipalities located in the extreme downstream sector of the Oder basin, their impact being significant on the Baltic Sea. ([20]) Their cost being 12 million ECU, the total investment would thus represent 1,492 million ECU.

The internal economic rate of return of the programme has been estimated at 9 %. This is highly satisfactory as a large number of other impacts cannot be measured in financial terms.The main benefits would be felt through improved drinking water supplies, less medical treatment and reduced corrosion.

The following accompanying measures are considered essential if this programme is to be successfully implemented:

- a reinforced level of international cooperation giving the soon to be created International Commission for the protection of the Oder a high level of responsibility in the preparation of environmental management programmes for the Oder basin,

- an assistance to the four Polish Oder basin Water Management Directorates created in February 1991, in addition to the short training courses being run under the auspices of bilateral assistance (mainly for monitoring activities, assistance in helping them make their first contacts with industries and municipalities as well as planning, managerial and financial activities),

- the training of technicians, mainly in municipalities, to efficiently operate and maintain the future treatment plants (to some extent this is also applicable to industry for the introduction of clean process technologies and to ensure that sufficient attention is paid to environmental protection),

- specific awareness and training activities for rural advisors and farmers.

The total cost of these accompanying measures, representing a 5 year programme, has been estimated at 17 million ECU ; this includes the cost of the foreign assistance which will be needed for specific studies (heavy metals) and technical and managerial support.

Consequently, the total cost of the recommended Priority Programme is estimated at 1,509 million ECU (proposed investments plus accompanying measures).

All investments and recurring costs have been summarised in the attached table 6.S. It gives two alternatives for a staged investment programme over a 10 year period. The second alternative places all non-priority investments in the second five year period.

[20] Municipalities of Police, Gryfino and Goleniow.

In this second alternative, costs are split into : million ECU

- for the first five year period:	1,031
- for the second five year period:	478

Recurrent expenses are estimated at 116 million ECU per year.

A recapitulation of costs of measures for HOT SPOTS is appended.

Table 6.S Action programme. Capital and Recurrent costs (million ECU - 1991 constant values)

YEAR		1	2	3	4	5	TOTAL 1 to 5	6	7	8	9	10	TOTAL 6 to 10	TOTAL 1 to 10	11[3] and follow.
1. Without fund constraint															
MUNICIPALITIES	investments	10[2]	259	258	259	258	1044	26	26	26	25	25	28	1172	
	recurrent costs [3]			13	34	54	101	75	84	86	88	90	423	524	94
INDUSTRIES	investments	3[2]	69	69	69	70	280	8	8	8	8	8	40	320	
	recurrent costs			3	10	14	27	20	20	21	21	22	104	131	22
AGRICULTURE		1	1	1	2	2	7						-	7	
ACCOMPANYING MEASURES		2	2	2	2	2	10						-	10	
TOTAL		16	331	346	376	400	1469	129	138	141	142	145	695	2164	116
of which	Foreign costs [4]	8	67	70	76	81	302	26	28	28	28	29	139	441	23
	Local costs	8	264	276	300	319	1167	103	110	113	114	116	556	1723	93
of which	investments	13	328	327	328	328	1324	34	34	34	33	33	168	1492	-
	recurrent costs	-	-	16	44	68	128	95	104	107	109	112	527	655	116
2. With fund constraint															
MUNICIPALITIES	investments	10[2]	201	201	201	202	815	72	72	71	71	71	357	1172	
	recurent costs			10	26	42	78	58	68	74	80	86	366	444	94
INDUSTRIES	investments	3[2]	49	49	49	49	199	25	24	24	24	24	121	320	
	recurent costs			3	7	11	21	14	16	17	19	21	87	108	22
AGRICULTURE		1	1	1	2	2	7						-	7	
ACCOMPANYING MEASURES		2	2	2	2	2	10						-	10	
TOTAL		16	253	266	287	308	1130	169	180	186	194	202	931	2061	116
of which:	Foreign costs [1]	8	51	54	58	62	233	34	36	37	39	40	186	419	23
	Local costs	8	202	212	229	246	897	135	144	149	155	162	745	1642	93
of which :	investments	13	250	250	250	251	1014	97	96	95	95	95	478	1492	-
	recurrent costs	-	-	13	33	53	99	72	84	91	99	107	453	552	116

[1] Not including replacement costs,
[2] Detailed design,
[3] 5% of investment cost for the first year of operation and maintenance and later on :
Municipalities = 8% (10.9 % for treatment plants, 5% for sewer systems),
Industries = 7%
[4] Foreign costs : 20% everywhere except = 50% for detailed design (the first year), for agriculture (the first year) and for all accompanying measures.

7. SUMMARY

The aims of this feasibility study were the preparation and evaluation of data for municipal, industrial and non point discharges from 1987 to 1995, with regard to the required 50% reduction by 1995.

In view of high potential pollution reduction, seven municipal treatment plants have been picked out as Hot Spots by a cost-benefit analysis. Besides the extension and construction of municipal treatment plants, supporting measures have been elaborated to implement pollution reduction for industrial and non point polluters in the long run.

7.1 Municipal Wastewater

For all municipal wastewater treatment plants in the project area, the relevant data have been collected and presented for the basic year 1987, the actual conditions in 1991 and the forecast for 1995.

The survey to get the data has been carried out in co-operation with the three former water management companies WMW, NW, NbgW and the Public Offices of the Environment (StAUN). The data have been checked in the field by LI

The data of all 48 municipal wastewater treatment plants and the seven Hot Spots have been evaluated separately in accordance with the aim of the HELCOM, 50% reduction of the pollutant load.
The seven Hot Spots have been screened by a cost-benefit analysis comprising all 48 listed treatment plants, considering environmental and economical aspects. A separate chapter describes the Hot Spot plants and the future planning, including a cost estimation.

In the project area BOD_5 and P_{tot} effluent load decreased evidently until 1991. For P_{tot} the HELCOM target could be met already in 1991 due to P-precipitation as emergency measure in some major treatment plants and the increasing use of P-free washing detergents.

The decrease of BOD depends on the liquidation or decrease of production of major industries and the above mentioned precipitation. For N_{tot} up to 1991 no significant change could be observed since steps for efficient nitrogen removal have not been taken (*figure 13*).

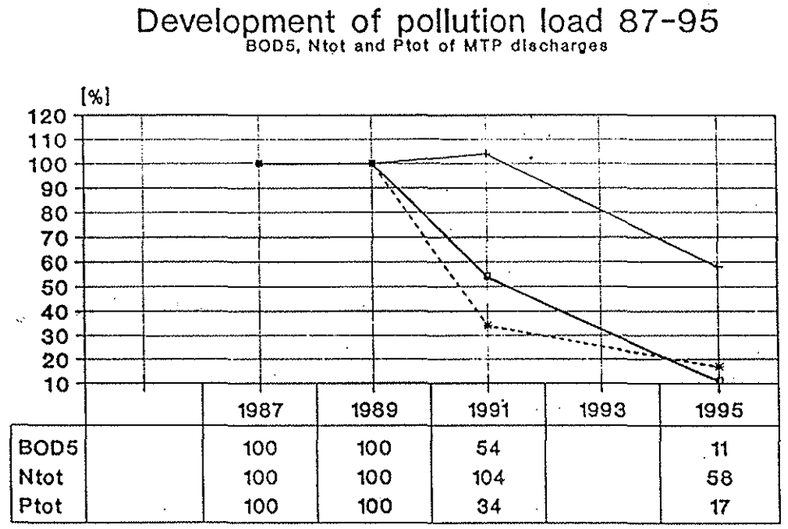


figure 13: Development of polution load 1987-1995

Up to 1995 the forecast points out several municipal treatment plants with nutrient removal. Thus the HELCOM target 50% reduction until 1995 can be achieved easily for BOD_5 and P_{tot} and can be met approximately for N_{tot}.

With regard to the seven Hot Spots the results look even better. Extension of these seven plants means 50% reduction for the pollution caused by the entire municipal wastewater treatment plants. A cost estimation has been carried out using the figures of built plants (price level 1992) and totals to:

7 Hot Spots	approx.	1.420 Mill. DM
41 Secondary Treatment Plants	approx.	1.770 Mill. DM
Sum	approx.	3.190 Mill. DM

7.2 Industrial Discharge

The data base for the directly discharging industry has been provided by the Public Offices of Environment (StAUN) in Mecklenburg-Vorpommern and evaluation of relevant literature.

The results measured in BOD, have been presented and evaluated separately for the two different levels (> 300 PE (UBA-FA 91-051) / > 4,000 PE (EC-guideline) in *chapter 5*.

For the 53 directly discharging industries which have been investigated (1987: > 300 PE), it has been found out that in spite of the economic and structural changes in Mecklenburg-Vorpommern the food industry, followed by metal-working industries will be still the main source of direct discharge. Due to the economic conditions, connections to public sewers and improvement of industrial pretreatment facilities, the reduction of the BOD_5-load will be more than 90% (1987: 7,348 t/a; 1995 465 t/a).

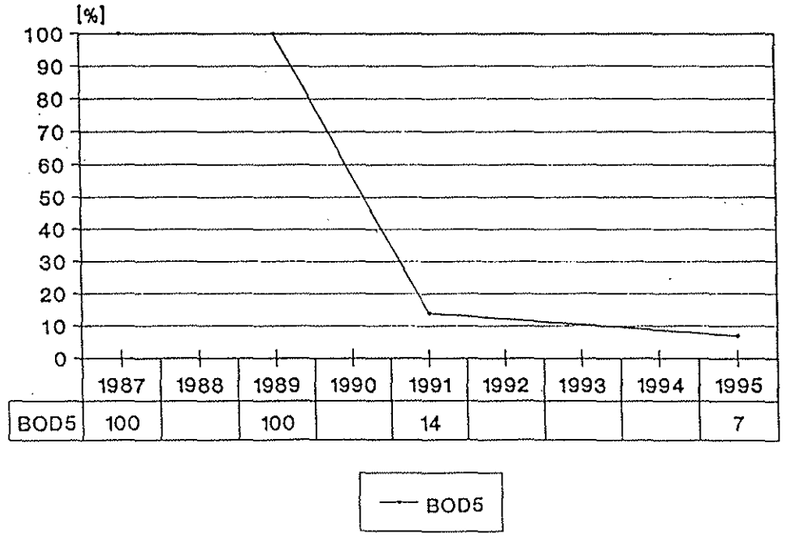


figure 14: Development of pollution load 1987-1995

Similar results show the evaluations of the industry with a discharge load of more than 4,000 PE (1987: 5,992 t/a; 1995 450 t/a), in the forecast for 1995 only three directly discharging industries are expected with a load equivalent to more than 4,000 PE. The change from direct discharge to connection for the public sewer has been considered within the study.

The HELCOM target 50% reduction for the directly discharging industry can be met easily (*figure 14*).

7.3 Non Point Pollution

The estimation for agricultural run-off is based on a statistical break down of the former GDR and for the period between 1991 and 1995 on material of the Agricultural Ministry of Mecklenburg-Vorpommern.

The data describe the amount of cultivated land patterns, their use and the number of cattle and the fertilizer application from 1987 to 1992 and some agricultural key parameters.

The relevant data allowed considering the preconditions in *chapter 6*, a nutrient balance for the forecast up to the year 1995. Since 1987 agricultural production has decreased strongly in every concern: cattle, crop production and consequently the consumption of fertilizers. As a parallel development storage capacity for fertilizers and manure has been extended.

For Mecklenburg-Vorpommern the forecast points out a reduction of phosphorous of approx. 52% and for nitrogen of approx. 73% for the time period 1987 until 1995 (*figure 15*).

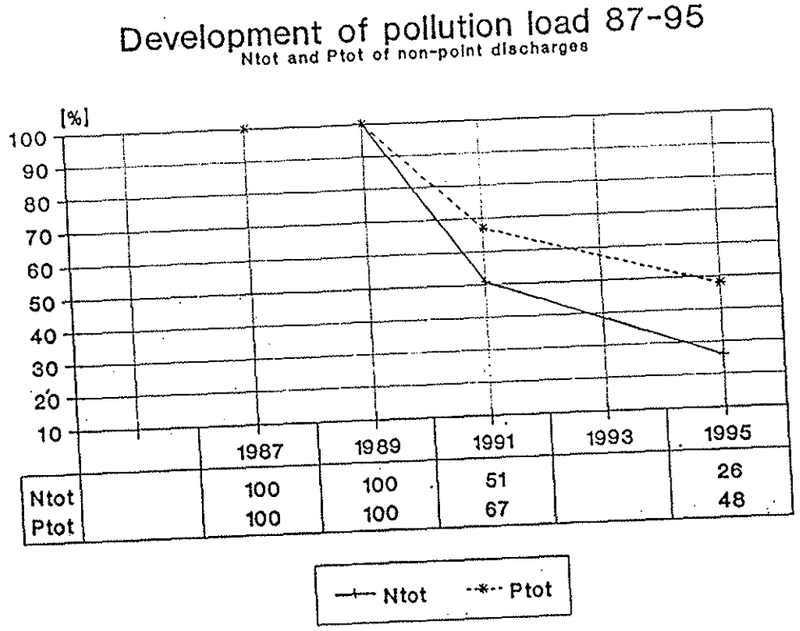


figure 15: Development of pollution loads 1987-1991

7.4 Results

In this chapter charts (*figures 16, 17, 18*) have been developed to overlay the figures of the three main sources of pollution: municipal sewerage, industrial discharge and non point pollution. The charts show clearly the estimated reduction for the time period 1987 - 1995.

- **BOD_5**

For the BOD_5 the HELCOM target will be easily achieved by 1995, considering the BOD_5-load caused by municipal sewerage and direct industrial discharge. Emphasis should be given to the change from direct discharging industries to more and more connections at the public sewerage system.

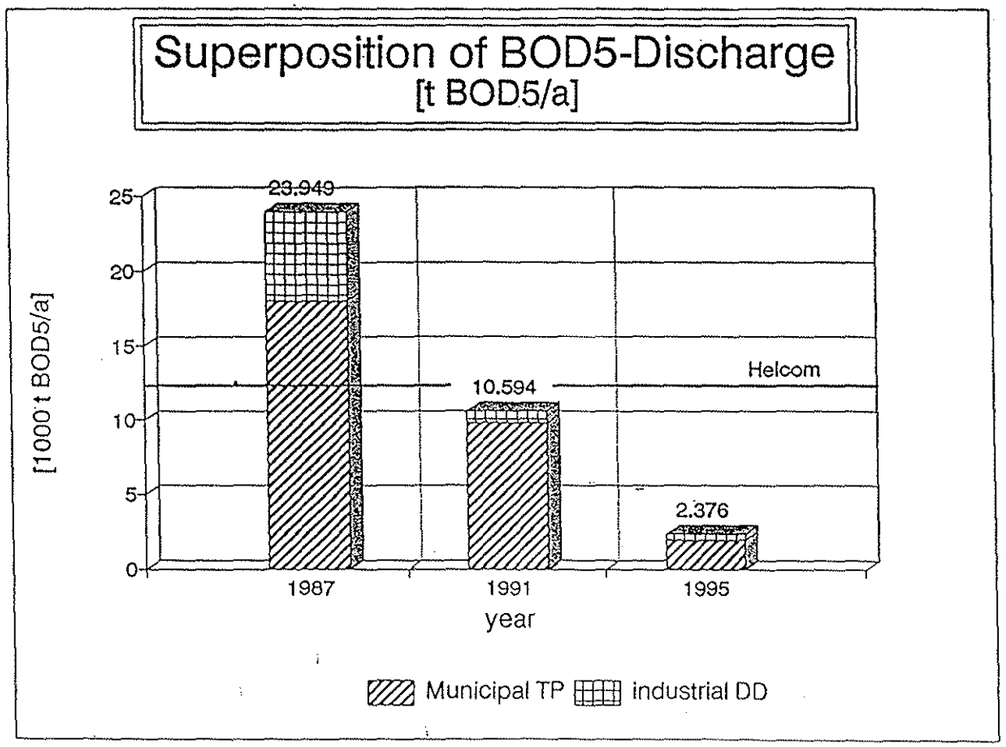


figure 16: Superposition of BOD_5-Discharge

- N_{tot}

With regard to the N_{tot}-load caused by municipal sewerage and non point pollution the 50% reduction can nearly be achieved up to the year 1995. The industrial share of the N-contamination was neglected.

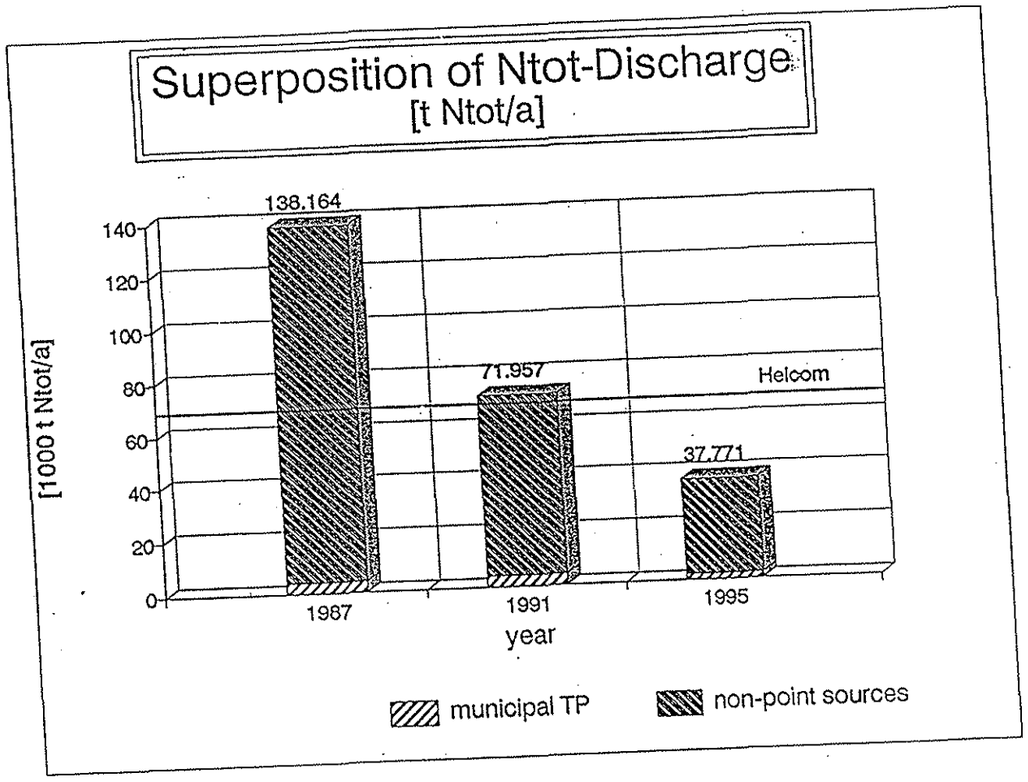


figure 17: Superposition of N_{tot}-Discharge

- P_{tot}

For phosphorous the HELCOM target can be achieved easily with regard to municipal wastewater and agricultural run-off. Similar to the N-load the industrial contribution for the P-contamination was neglected.

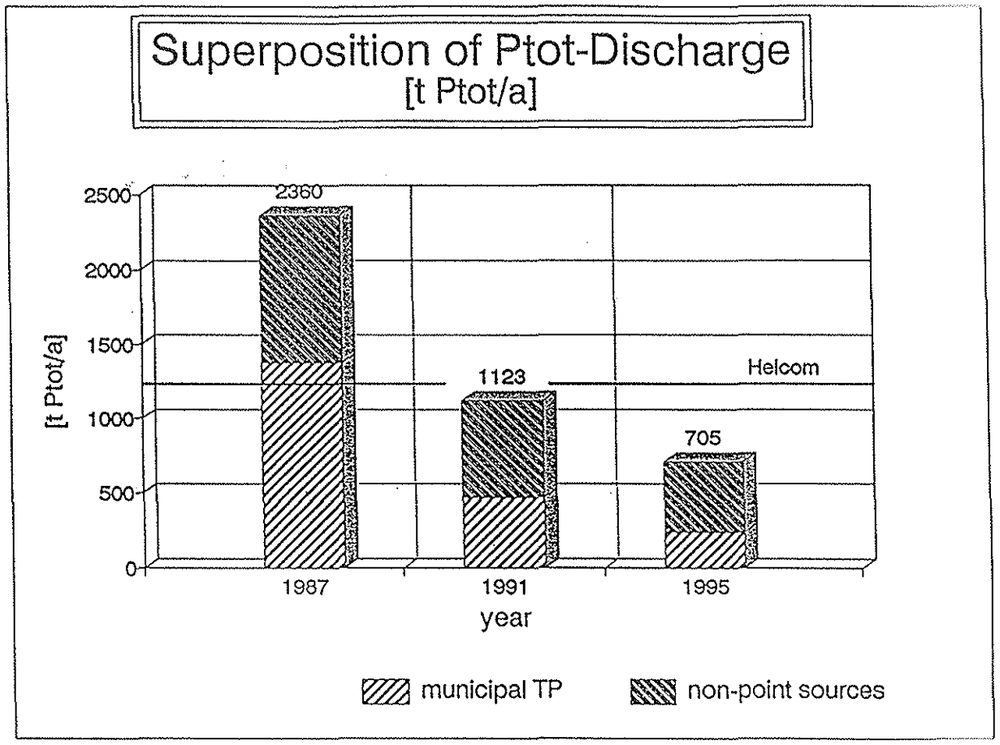


figure 18: Superposition of P_{tot}-Discharge

C. THE TOPICAL AREA STUDIES

The Topical Area Study for Atmospheric Deposition of Pollutants

Executing Agency: European Bank for Reconstruction and Development (EBRD)
Consultant: Norwegian Institute for Air Research, NILU

Status: Final Synthesis Report, July 1992
Final Technical Report, July 1992

The Topical Area Study for Agricultural Runoff

Executing Agency: European Bank for Reconstruction and Development (EBRD)
Consultant: Norwegian Institute for Water Research, NIVA

Status: Final Synthesis Report, April 1992
Final Technical Report, April 1992

The Wetlands - Vital Ecosystems for Nature and Societies in the Baltic Sea Region

Financed and prepared by World Wide Fund for Nature, WWF, Sweden

Status: Report, November 1991

European Bank
for Reconstruction and Development

BALTIC SEA ENVIRONMENT PROGRAMME

TOPICAL AREA STUDY

FOR AGRICULTURAL RUNOFF

FINAL SYNTHESIS REPORT

APRIL 1992

Norwegian Institute for Water Research NIVA

EXECUTIVE SUMMARY

OBJECTIVES AND SCOPE OF WORK

The Topical Area Study for Agricultural Runoff, which is part of the Baltic Sea Environment Programme, was initiated by the European Bank for Reconstruction and Development (EBRD) with the objectives:

Estimate the pollution load from agricultural runoff both to local waters and to the Baltic Sea.

Propose a Priority Action Programme of abatement measures against agricultural pollution.

Assess the environmental benefits of this action plan both with regard to local waters and for the Baltic Sea.

Estimate the costs confined with this action plan.

Evaluate accompanying measures, like environmental legislation, human and institutional strengthening, etc.

The study area comprises the St. Petersburg Region, Estonia, Latvia, Lithuania, the Kaliningrad Region, Vistula River Basin, Odra River Basin, and The North German Coast. The data should be provided by the consutants responsible for the prefeasibilty studies within each region.

AGRICULTURE STATUS AND TRENDS

In the St. Petersburg Region, Estonia, Latvia, Lithuania, and the Kaliningrad Region, the agriculture is characterized by the predominant former USSR agricultural policy with very large state owned farms of an average size of more than 5000 ha. Animal husbandry dominates and provides for about 70% of the economic output from agriculture. The animal husbandry is characterized by large specialized units comprising cattle farms, poultry farms and piggeries.

Manure storage capacity is in general insufficient. Storage capacity for manure is about 3 months. Indoor leakage proof storages of "Western standard" do almost not exist. Handling of urine is normally dealt with by mixing urine with other waste waters and thus urine will enter the sewers from the farm complexes. The waste water is either discharged directly into a recipient or at best via a biological treatment plant removing organic material but not nutrients. For some cattle and poultry farms manure is mixed with peat and composted. The solid manure is for the most applied on agricultural land.

The most severe problem with manure storage and handling is manure from the piggeries. The manure handling technology is based on hydraulic systems both with regard to cleaning and transportation.

Table S1. Essential agricultural statistical data from the different Prefeasibility Regions.

	Agricult. area (ha) x1000	Animal Units (AU) x1000	Animal Density AU per ha	Mineral Fertilizer (total consume)		Manure Fertilizer (total production)		Mineral Fertilizer Application rate		Manure Fertilizer Application rate		Total fertilizer (mineral + manure)	
				Tons N	Tons P	Tons N	Tons P	kgN/ha	kgP/ha	kgN/ha	kgP/ha	kgN/ha	kgP/ha
St. Petersburg Reg.	555	610	1.1	49500	6050	30500	6100	90	35	55	11	145	46
Estonia	1362	675	0.5	110000	27000	34000	6800	80	20	25	5	105	25
Latvia	2570	2000	0.8	177000	51000	100000	20000	69	20	40	8	110	28
Lithuania	3425	2454	0.72	398700	115000	122700	24540	116.4	33.6	35.8	7.2	152.2	40.8
Kaliningrad Region	789.1	418	0.53	37700	10872	20900	4180	47.8	13.8	26.5	5.3	74.3	19.1
Vistula	12495	9200	0.74	810000	220000	460000	92000	75	20	37	7.4	112	27
Odra	7080	5000	0.7	531000	141600	250000	50000	75	20	35	7	110	27
Former DDR	1190.6	1187	1	166690	33338	71220	11870	140	28	60	10	200	38
Sleswig Holstein	1074.6	1491	1.38	124654	20417	89460	14910	116	19	83	14	199	33

In Poland is most of the farms privately owned. The private farms are of an average size of only 5 ha. There are also several large state owned farms in Poland with huge livestock numbers causing the same environmental problems as in the previous described area. Both on private farms and state farms is manure storage capacity insufficient. With regard to fertilizer consumption is the Polish agriculture characterized as medium intensive.

In Germany there is a highly intensive agriculture both with regard to plant cultivation and animal husbandry. In the former DDR there are large livestock farms as in the former Soviet areas with huge pollution problems arising from bad manure handling and storage.

The intensity of the agriculture within the different region is given in Table S1. It should be noted that large changes are at the moment taking place concerning the ownership of many farms, consumption of mineral fertilizers, etc., in large parts of the area in study. The statistics are mostly from the period just before this changing started, 1988/89/90.

NUTRIENT LOAD FROM AGRICULTURE

Nutrient load to local waters, lakes and rivers

The nutrient loading to local water recipient from different agricultural sources within the different prefeasibility regions is given in Table S2 to S10.

Table S2 Estimated nutrient load from agriculture to local water recipients in the Kaliningrad Region.

Pollution categories	Nitrogen (tonnes N/year)	Phosphorus (tonnes P/year)
Average runoff from agricultural fields	15000	160
Extra loss from heavily manured fields	1900	50
Direct discharge of farm waste (slurry)	7200	1430
Leakage from manure storages	3140	420
Leakage from fertilizer storage	700	120
Silage effluent leakage	400	50
Total nutrient load from agriculture	28340	2230

Table S3 Estimated nutrient load from agriculture to local water recipients in The St. Petersburg Region.

Pollution categories	Nitrogen (tonnes N/year)	Phosphorus (tonnes P/year)
Average runoff from agricultural fields	13700	170
Extra loss from heavily manured fields	2700	75
Direct discharge of farm waste (slurry)	4500	900
Leakage from manure storages	4500	600
Leakage from fertilizer storage	600	140
Silage effluent leakage	300	60
Total nutrient load from agriculture	26300	1950

Table S4 Estimated nutrient load from agriculture to local water recipients in Estonia.

Pollution categories	Nitrogen (tonnes N/year)	Phosphorus (tonnes P/year)
Average runoff from agricultural fields	27400	280
Extra loss from heavily manured fields	3500	90
Direct discharge of farm waste (slurry)	5100	1020
Leakage from manure storages	5000	650
Leakage from fertilizer storage	1300	200
Silage effluent leakage	500	65
Total nutrient load from agriculture	42800	2305

Table S5 Estimated nutrient load from agriculture to local water recipients in Latvia.

Pollution categories	Nitrogen (tonnes N/year)	Phosphorus (tonnes P/year)
Average runoff from agricultural fields	59110	650
Extra loss from heavily manured fields	7500	200
Direct discharge of farm waste (slurry)	10000	2000
Leakage from manure storages	15000	2000
Leakage from fertilizer storage	1700	300
Silage effluent leakage	1500	200
Total nutrient load from agriculture	94810	5350

Table S6 Estimated nutrient load from agriculture to local water recipients in Lithuania.

Pollution categories	Nitrogen (tonnes N/year)	Phosphorus (tonnes P/year)
Average runoff from agricultural fields	85600	1030
Extra loss from heavily manured fields	9200	250
Direct discharge of farm waste (slurry)	9800	1900
Leakage from manure storages	18000	2400
Leakage from fertilizer storage	3500	600
Silage effluent leakage	1800	240
Total nutrient load from agriculture	127900	6420

Table S7 Estimated nutrient load from agriculture to local water recipients in the Polish part of Vistula Catchment and the Baltic Coast of Poland.

Pollution categories	Nitrogen (tonnes N/year)	Phosphorus (tonnes P/year)
Average runoff from agricultural fields	280000	2500
Extra loss from heavily manured fields	13000	360
Direct discharge of farm waste (slurry)	9200	1800
Leakage from manure storages	32000	3700
Leakage from fertilizer storage	3000	480
Silage effluent leakage	3400	460
Total nutrient load from agriculture	340600	9300

Table S8 Estimated nutrient load from agriculture to local water recipients in the Oder River Basin.

Pollution categories	Nitrogen (tonnes N/year)	Phosphorus (tonnes P/year)
Average runoff from agricultural fields	162000	1540
Extra loss from heavily manured fields	7500	200
Direct discharge of farm waste (slurry)	5000	1000
Leakage from manure storages	17000	2000
Leakage from fertilizer storage	1900	300
Silage effluent leakage	1800	250
Total nutrient load from agriculture	195200	5290

It has not been data available to perform these calculations for the North German Coast.

Nurient load from agriculture reaching the Baltic Sea

From runoff:
Corrected for assumed retention in primary and secondary recipients, the nutrient load from agricultural runoff that reach the Baltic Sea from the differnt regions are estimated as follows.

Table S9 Estimated nutrient loading to the Baltic Sea arising from agriculture runoff in the Prefeasibility Regions.

Prefeasibility Region	Nitrogen (tonnes N/year)	Phosphorus (tonnes P/year)
St. Petersburg Region	5260	680
Estonia	8560	810
Latvia	18960	1870
Lithuania	25580	2250
The Kaliningrad Region	5670	780
The Vistula River Basin	68120	3260
The Oder River Basin	39040	1850
The North German Coast		
Total from agriculture	171190	11500

From ammonia deposition

Table S10 Total annual ammonia deposition onto the Baltic Sea surface arising from the prefeasibilty region, tentatively after the table 1 in NILU synthesis report (Pacyna 1992).

Contributor (Prefeasibility region)	Ammonia deposition (tonnes per year) Based on 1985 data
St. Petersburg Region, Estonia, Latvia, Lithuania, Kaliningrad Region	20000
Vistula River Basin and Oder River Basin	16500
Schwerin and Neu Brandenburg (DDR)	4500
Schleswig-Holstein	3000
Total N-load from ammonia deposition	44000

Total nutrient load from agriculture within the prefesibilty regions to the Baltic Sea is estimated to 11000 tonnes of Phosphorus and 208000 tonnes nitrogen.

PRIORITY ACTION PROGRAMME

One important long term measure should be to split the large farms into smaller units which are much more easy to run after environmentally sound principles. However, this will take at least one generation to perform. In the mean time the short term measures that should be implemented are as follows:

Animal husbandry

It is quite obvious that the largest pollution sources from agriculture is confined within the animal husbandry. The following measures must be implemented.

1) Increase the storage capacity of manure to approximately 8 months, which is necessary to avoid spreading of manure outside the growing season.

2) Ensuring sufficient technical standard of the manure storage facilities. They should be roofed over and with no leakages both to ground- and surface waters.

3) Stop the direct discharge of liquidized manure/ farm wastes.

4) Stop dumping of manure on small areas.

5) Avoid outdoor storages of manure, particularly the lagoon solution.

6) Ensuring sufficient capacity and standard of silage storages.

7) Ensure safe storages for mineral fertilizers and other agrochemicals.

8) Reduce the volume of water in piggeries to what is necessary to make the manure pumpable.

10) Change from high spreading equipment to low spreading equipment in manure application (reduce ammonia volatilization).

11) Incorporate manure into soil without delay after application by plowing or harrowing (reduce ammonia volatilization).

Runoff from agricultural fields

It does not seem to be much nutrient reduction to achieve from measures against this kind of diffuce pollution sources other than:

Reduce autumn tillage as much as possible, especially on erosion exposed fields, which, however, are few.

Increase the use of catch crops.

It is, however, likely that the effect of these measures will be counteracted by increased tile drainage, and other means of effectivization in the agriculture in the future.

ACCOMPANYING MEASURES

To assure an environmentally sound agriculture in the future the accompanying measures that should be developed are:

Institutional strengthening.

Develop Advisory service, e.g. to help farmers setting up fertilizing plans, etc.

Increase both the capacity and quality of agricultural education.

Develop and adopt environmental legislation and standards.

Develop effective Pollution control services and /authorities, including use of fines.

Bring environmental aspects into agricultural policy.

Active use of subsidies to achieve extensivation where it is needed.

Use of taxation to achieve sound use of agrochemicals/ better utilization of manure.

Development of agro-related infrastructure, to secure the farmers with necessary supplies and secure storage, distribution and sales of the agricultural products.

BENEFITS FROM THE PRIORITY ACTION PROGRAMME

The actions will improve the water quality both in local waters (lakes and rivers, ground waters) and in the Baltic Sea. The improvement is quantified by the estimated loading reductions:

Load reductions to local waters:

Table S11 Reductions in nutrient load (annual) from agriculture to the local surface water recipients as a result of the Priority Action Plan.

Prefeasibility Region	N-reductions (tonnes N/year)	(%)	P-reductions (tonnes P/year)	(%)
St. Petersburg Region	11400	43	1616	83
Estonia	13990	32	1843	79
Latvia	32300	34	4260	79
Lithuania	38420	30	4911	76
The Kaliningrad Region	12076	43	1875	80
The Vistula River Basin	54840	16	6168	66
The Oder River Basin	30070	15	3405	64
The North German Coast				
Total from agriculture	193096		24078	

Load reductions to the Baltic Sea

Adjusting the local pollution load reductions for retention in primary and secondary recipients the corresponding total load reductions to the Baltic Sea from agricultural runoff are estimated to:

39000 tons of nitrogen per year (23% reduction of present runoff load)
8400 tons of phosphorus per year (73% reduction of present runoff load)

These figures apply to agricultural runoff. In addition comes ammonia deposition directly onto the Baltic Sea surface. According to the NILU study "Topical area study for atmospheric deposition of pollutants" it is possible to reduce the loading from ammonia deposition by 60% via measures within the agricultural sector. How much of the total ammonia deposition onto the Baltic Sea arises in the Prefeasibility regions is uncertain. We have tentatively estimatet this to 44,000 tonnes N per year, of which 26000 tonnes can be removed by the measures in the priority action plan.

The total N load from agriculture of approximately 208 000 tonnes (runoff + deposition) can then be reduced by 65,000 tonnes N which equals a 31% reduction.

CAPITAL AND RECURRENT COSTS CONFINED WITH THE ACTION PLAN

The total investment costs confined with the priority action plan in the agricultural sector in the different prefeasibility study areas are given below. The cost estimate is based on the Norwegian price level in 1991.

Table S12 Total investment costs confined with the Priority Action Plan in the agricultural sector in the different prefeasibility study areas.

Prefeasibility region	Investment Costs (mill. ECU)
St. Petersburg Region	1056
Estonia	1168
Latvia	3434
Lithuania	4211
Kaliningrad Region	731
Vistula River Basin	15728
Odra River Basin	8552
Former DDR	2039

Summarizing it gives total investment need of 37 billion ECU if the former DDR is included and about 35 billion ECU if DDR is omitted. The cost estimate is based on the Norwegian price level in 1991.

The capital costs (pro annum) confined with these investments will depend on the conditions, rate of interest, and so on offered by the banks and financial institutions involved.

Recurrent cost, comprising operating and maintenance costs, are very low as the investments include mainly simple buildings and/or traditional farm machineries. There are no treatment plants which needs special trained or educated personnel, nor any expensive process chemicals. There will not be any increased demand for energy for heating.

The only recurrent costs will comprise normal maintenance of buildings and tractors, increased diesel consumption in manure spreading, and some electricity to run the manure pumps. These costs are at maximum 4% of the investment, i.e. about 1.5 billion ECU per year.

The real lifetime of the buildings, manure storages, silage storages, pipeline systems are estimated to about 50 years, while the tractors and spreading equipment, pumps, etc. have a maximum lifetime of 15-20 years.

Wetlands – Vital Ecosystems for Nature and Societies in the Baltic Sea Region

WORLD WIDE FUND FOR NATURE, WWF

Report to the

HELCOM AD HOC HIGH LEVEL TASK FORCE,

November 1991

Written by:

Magnus Rydlöv/Helene Hasslöf
Mäster Eriks Plan 7D
S-211 58 Malmö
Sweden

Karin Sundblad/Kerstin Robertson
Department of Water and Environmental Studies
Linköping University
S-581 83 Linköping
Sweden

Hans Bertil Wittgren
Environmental Hydrology Group
Swedish Meterological and Hydrological Institute
S-601 76 Norrköping
Sweden

SUMMARY

Wetlands – essential biotopes and landscape elements

This report is an attempt to illustrate the importance of wetlands in the Baltic Region. In the efforts to restore the Baltic Sea to a sound ecological balance, wetlands are mentioned as possible cost-effective means to reduce the nitrogen input to the sea. Lakes and wetland areas in catchments can under certain circumstances be regarded as nutrient sinks. In this study the wetlands are put into a broader ecological context. They are regarded not only as nutrient sinks, but also as essential habitats and ecosystems for plants and animals. In addition the potential to construct wetlands for treatment of wastewater is highlighted.

The concept ecological balance means a clean environment that harbours healthy populations of flora and fauna. Fulfilment of this goal requires extensive action to reduce both discharges of toxic substances and excessive circulation of nutrients. Also the demands of healthy populations must be met. This means that the variation of biotopes must be safeguarded, so that enough of the different biotopes are left for the populations depending on them to survive in the long term.

Some species have adapted to the specific environment of one wetland type, and depend on it for their survival. Some species occur in different biotopes and are only partly depending on wetlands. Yet other species have once occurred in different biotopes, but now use wetlands as refuges because the other habitats have been changed by human activities.

Extraordinary botanical richness is found in nutrient-rich wet forests that have not been subject to drainage and in lime-rich wetlands as spring fens and extreme rich fens.

Through their mobility, birds highlight the fact that wetland conservation is an international concern. Migrating waterfowl need wetlands as resting and feeding areas along their flyways. Coastal wetlands with a high production of small animals give the birds essential energy for the onward flight.

Anthropogenic impact on wetlands in the Baltic Sea Region

Drainage

Intensification of agriculture and forestry has included extensive drainage of lakes and wetlands, particularly in the western countries of the Baltic region. Today the landscape as a whole is drier, and more uniform. Drainage to gain agricultural land has been going on for some two hundred years, whereas forestry today is the most important reason for wetland drainage.

In Denmark, some 80 % of the seashore meadows, and 70-90 % of the wet meadows, bogs and fens are gone. In southern Sweden 90 % of the wetland area has been drained. In Sweden as a whole, about 20 % of all land with a peat layer has been drained. The drainage figure for Finland is much higher: 70 % of all mires are drained, and a new programme of drainage on previously drained mires has started recently. In Poland, as much as 90 % of the peatlands may have been drained. For Estonia the figure is 25 %.

The numbers are approximate indeed, and comparisons are also complicated by differences in drainage methods. In Poland, for instance, many ditches are hand-made and less deep than the machine-dug ditches of modern forestry. And in Latvia, ditches

are poorly maintained and therefore ineffective, a fact that many wetland plants and animals benefit from.

Drainage of wetlands to achieve more agricultural land decreases the nutrient retention capacity within a certain river basin, but it also effectively increases the load of nutrients from the basin. This is explained by the drastic changes in soil nutrient cycles that takes place after drainage. Most wetland soils are very rich in organic matter and many also in nutrients, e.g. nitrogen. Drainage will change the status of the soils from reduced to oxidized conditions. This increases decomposition of organic matter and mineralisation of nitrogen. Solubilization of organic forms of nitrogen may also be a primary process responsible for the release of nutrients from drained wetland soils.

The magnitude of the nitrogen losses from cultivated former wetlands around the Baltic Sea is hard to estimate. However, a study of a wetland area on the island Gotland serves as an example of the possible importance of such changes (Folke, 1991). This area was originally a complex of fens and shallow lakes, covering an area of 34 km^2, with about 11 km^2 open water. After extensive ditching and draining, cultivation has caused rapid decomposition and erosion of the peat soils. According to rough estimations the corresponding nitrogen losses amount to about 15 - 100 tonnes·ha^{-1} which have been lost during about one century.

This example shows that extensive drainage projects may have had, and still have, a quite significant role for the nutrient load to the Baltic Sea. Many of the drained areas are peaty soils in river valleys or in areas close to the sea. From such areas there is a low retention and leaching nitrogen may rapidly reach the coastal waters.

Reduced management in certain wetlands

The distinction between wetlands needing management and natural wetlands is important. Areas not affected by human management have a natural succession where the final stage often is a forest. Exceptions are open bogs and fens, where the immobile ground water creates oxygen-free conditions preventing tree growth. On rised bogs also acidity and lack of nutrients are detrimental to trees.

On the other hand, many of the wetland biotopes have been managed for a long time, sometimes continually since the iron-age. Cattle grazing and haymaking have kept the areas open. These lands have had time to develop a characteristic and species-rich flora and fauna. Many of these biotopes are important to insects, as they hold specific host plants. They are also important to plants, birds, amphibians, bats and others.

Managed wetlands used to be important to the farmer, as they were relatively nutrient-rich. Management has ceased successively, as commercial fertilizers and machinery have made these areas unnecessary. This leads to overgrowth, where the species adapted to the open environment are lost. The invading species are mostly species, which are already common in other areas.

Pollution

Excessive eutrophication and acidification are general problems that affect all biotopes. Forests and lakes have been particularly noted in the acidification debate, whereas freshwater and the marine environment are mostly in foci when eutrophication is discussed. Eutrophication of wetlands occurrs through atmospheric deposition of nitrogen or increasing nutrient concentrations in the inflow. Drastic changes in both fauna and flora is often the result of such increases in nutrient loads.

Some wetlands have recieved, or are receiving, large amounts of toxic substances, e.g. heavy metals and organic compounds. In many cases this has taken place intentionally, since wetlands have often been considered wastelands. Such compounds can affect life directly or are gradually accumulated in organisms on higher trophic levels. In such

11 432491U

cases the toxic effects may occurr after a considerable time delay. In view of the long-term and widespread threat this poses to living organisms, strong action should be undertaken to stop such activities immediately.

Present status for wetlands in the Baltic Sea Region

Presently, the major threats to wetlands can be divided into two groups, biotope destruction and pollution:

a. Biotope destruction
   - drainage
   - ceased management

b. Pollution
   - discharge of toxic or non-natural substances
   - overflow discharge of nutrients

Although pollution is severe in the eastern states, less modernized agriculture and forestry has resulted in less spoiled nature. Large areas with a still to a large extent unspoiled richness of habitats and species are found in parts of Estonia, Latvia, Lithuania, northeastern Poland and the northern parts of eastern Germany.

Life in shallow waters is threatened by eutrophication and pollution, exploitation and recreational activities. Fishery in the Baltic Sea is depending on the shallow waters, as these are spawning and nursing areas for many fish species. A continuing decrease of the area with healthy shallow waters is a threat to the fishery in the Baltic.

A small number of large unregulated natural rivers still exist in the region. These include flooded wetlands of extraordinary biological value, because such biotopes are very rare. Along natural rivers, specific land forms are created. These are inhabited by plant and animal species with highly specific needs. When the shores are flat and easily eroded, the river gets a meandering course. Material is continually transported, the shorelines move and ecologically significant vegetation zonations are created.

Examples of such rivers are:
Poland: Biebrza river and other contributaries to the river Vistula; Poland/Germany: River Odra; Sweden: The rivers Vindelälven, Kalixälven, Piteälven, Torneälven; Finland: The Kemijoki river system.

Seashore meadows presently decrease in size and quality throughout the region. Cattle grazing is no longer as profitable as before, and management has ceased successively. A large number of species depending on seashore meadows are threatened.

The seashore meadows are significant also as breeding grounds for various bird species. Individuals of Dunlin *Calidris alpina schinzii*, Black-tailed godwit *Limosa limosa* and Ruff *Philomachus pugnax* even breed in different areas in different years. National borders are not recognized by these birds and discussions on conservation of seashore meadows should take the whole region into account.

The wet forests often have virgin forest qualities. Within the Baltic Sea region there are still valuable wet forests. This biotope is one of the most threatened, due to extensive drainage. The wet forests offers a broad variety of niches used by different species. An example is the moisture gradient from small pools of water up to dry tufts. Nutrient-rich wet forests is by far the most species-rich of all forest biotopes.

Wet forests flora holds some characteristic species that are hosts for insects, not found in other forest biotopes. Wet forests also plays an important role as refuges for a large

number of animal species. The lower fauna is offered a wide spectrum of habitats, partly due to the variation in ground moisture. Therefore, the species richness is large.

Peatlands is the best documented wetland category, in quantitative terms. This is because the peat has been and still is regarded as a valubale natural resource and has been exploited for several purposes. A characteristic mire type is the so called flark or aapa mire, found in northern Sweden and Finland which is quite unusual in the rest of the world. Lime-rich spring fens and rich fens are worth protecting mainly for their rich flora. Bogs are found mostly in areas with high precipitation, generally in the south-western parts of the region. Fens are more abundant in the east and north.

In proportion to the land area, Finland is richest in peatlands of the Baltic states, 29 % of the land area is occupied by peatlands. Estonian peatlands cover 22 %, Karelian USSR 18 %, Latvian 15 %, Swedish 14 %, Lithuanian 8 % and Polish 4 % of the land area. The figures include drained peatlands. Comparisons are complicated by the fact that wetlands are classified in different ways in different countries, and the figures should be taken as approximations.

Wetlands and aquatic ecosystems as sinks for nitrogen

Important transformation processes

Measured rates of processes in the nitrogen (N) cycle are reviewed. Net sedimentation, NH_3 (ammonium) volatilization, other gaseous losses, and harvesting of biomass are the long-term nitrogen processes. Short-term retention, i.e. retention within or over only a few years, is caused by gross sedimentation, plant and microbial uptake.

NH_3 volatilization is generally low. Denitrification exceeds N fixation in most aquatic systems. In oligo- and mesotrophic waters, N fixation rarely accounts for more than 1% of the annual input. In eutrophic waters, on the other hand, rates are often high, especially where low N/P ratios occur. Plant uptake seems to be of the same order of magnitude as denitrification. Potential rates commonly exceed those measured *in situ* by at least one order of magnitude.

Assimilation of N by plants algae and microorganisms is favourable if the organic N produced is subsequently permanently incorporated into the sediment or removed from the system by means of harvesting. This is, however, only the case with a minor part of the annual production, of which most is returned to the system by means of leaching and mineralization. Plants might also recirculate N in the sediment by means of root uptake. This assimilation also competes with the denitrifying bacteria for the NO_3^- present. On the other hand, it provides organic matter, which is needed as energy and carbon source by the denitrifiers. Further, if the availability of phosphorus is ample, the N fixation by cyanobacteria in the waters might increase. In conclusion, in general denitrification and net sedimentation are larger, in relation to other N transformation processes, in eutrophic systems. Harvesting of the flora and/or fauna would, of course, optimize the N retention.

Since all processes except for sedimentation are biological, the activities within the nitrogen cycle are reduced during winter. Loadings of inorganic as well as organic N on wetland systems may therefore pass through more or less unaffected.

Retention of nitrogen from non-point sources

Any retention of nitrogen in lakes, rivers or different wetlands is highly related to the total load and the seasonal distribution of the load. As stated above, the activity is low during the cold period. Thus, if the majority of nitrogen runoff occurs during a short spring and winter period the retention will be relatively low. Many of the existing

wetlands do not receive high loads of nitrogen simply because the water flow through them is rather low. This is, e.g. true for many fens and paludified areas.

In contrast, riverine, lacustrine and coastal wetlands may have a higher water throughflow, and thus potentially higher loads of nitrogen. Studies of N transformations in drainage water draining through riverine meadows have demonstrated the potential for high retentions, e.g. 39 $g \cdot m^{-2}$. In conclusion, a wetter landscape where field drainage water passed through the sediments of riverine wetlands would certainly retain more N lost from the terrestrial environment. However, this would require major changes of the drainage projects that have been undertaken.

Lakes have been shown to retain nitrogen efficiently. No clearcut relationship exists between load and estimated retention, and values ranging from 17 - 50 % has been observed on an annual basis. Annual retention as high as 83 $g \cdot m^{-2} \cdot yr^{-1}$ has been observed in Danish lakes. Thus, the amount of lakes is certainly of great importance for the retention in river basins.

Constructed wetlands for wastewater treatment

The interest in using constructed wetlands for wastewater treatment has been growing rapidly in the 1980´s. Several systems have been studied and they might be classified according to hydrological principles as:

I. Surface flow aquatic systems
a. Floating or submerged vegetation
b. Emergent vegetation

II. Subsurface horizontal flow systems

III. Infiltration systems
a. Intermittent flooding
b. No flooding

The surface flow systems have received little attention in temperate climate. The same is true for infiltration systems, in spite of the fact that systems without plants are fairly common. The subsurface horizontal flow systems, however, have been widely applied in Denmark, other countries within the European Community, Australia, and in the USA.

The performance of the Danish, so called root-zone plants have been investigated recently, and the results are reviewed here in some detail. The Danish plants were, as a rule, overloaded. This resulted in significant surface runoff. Still, at loads of 5-10 g $BOD \cdot m^{-2} \cdot d^{-1}$, they met discharge criteria for both suspended solids and BOD, but not for phosphorus and nitrogen.

Based on these findings it is suggested that wastewater treatment systems based on constructed wetlands and related systems, are designed in three steps: i) settlement tanks, removal of suspended solids, ii) surface flow wetlands with emergent vegetation: for further removal of suspended solids and BOD, iii) systems based on soil passage of wastewater and, possibly, plant harvest for nutrient removal and recycling. Aquatic systems with floating or submerged vegetation may also be an alternative, but these systems will probably require intense harvesting to maintain endurable nutrient removal, especially for phosphorus.

For wastewater that has already received advanced treatment for removal of BOD and phosphorus, surface flow wetlands are suggested for nitrogen removal. This might be a

cost-effective alternative to the more compact technology that is currently installed in several Scandinavian wastewater treatment plants.

A unique opportunity

Especially in the eastern part of the Baltic Sea region there are still wetland biotopes with a great biological diversity. Much of these areas and diversity have already already lost in the western countries. Time may be running out if the most valuable biotopes are not to be lost in the near future. The countries around the Baltic have through their decision to cooperate for the restoration of the ecological balance a unique opportunity to save these biotopes for coming generations. This requires knowledge, politcal will and economic resources and international cooperation.

As a starting point, recommendations for future activities regarding protection, use and construction of wetlands are proposed. These recommendations covers a wide range of subjects, from identification of particularly valuable biotopes to the importance of aquatic compartments in the landscape, and proposals for construction of wastewater treatment wetlands.

D. REFERENCES

PRE-FEASIBILITY STUDIES

1. ST. PETERSBURG, ST. PETERSBURG REGION, KARELIA AND ESTONIA

Ministry of the Environment of Finland, 1991. Environmental priority action programme for Leningrad, Leningrad Region, Karelia and Estonia. Synthesis Report. Plancenter LTD. 191 pp.

-"- Pre-Feasibility Study No 1. 1991. Implementation of the phosphorus removal at waste water treatment plants of the city of Leningrad. Plancenter LTD. 26 pp.

-"- Pre-Feasibility Study No 2. 1991. Construction of suburban waste water treatment plants in Leningrad. Plancenter LTD. 26 pp.

-"_ Pre-Feasibility Study No 3. 1991. Pretreatment of heavy metal containing waste waters in Leningrad. Plancenter LTD. 40 pp.

-"- Pre-Feasibility Study No 4. 1991. Connection of the direct discharging sewers to the collectors of the treatment plants in Leningrad. Plancenter LTD. 32 pp.

-"- Pre-Feasibility Study No 5. 1991. Hazardous waste management in Leningrad. Plancenter LTD. 32 pp.

-"- Pre-Feasibility Study No 6. 1991. Development of livestock farming waste management in the Leningrad Region. Plancenter LTD. 33 pp.

-"- Pre-Feasibility Study No 7. 1991. Reduction of the environmental effects of Syasstroy pulp and paper mill and Volkhov aluminium factory. Plancenter LTD.

-"- Pre-Feasibility Study No 8. 1991. Reduction of the environmental effects of Svetogorsk pulp and paper mill. Plancenter LTD. 5 pp.

-"-- Pre-Feasibility Study No 9. 1991. Reduction of the environmental effects of Kostamuksha combine. Plancenter LTD. 14 pp.

-"- Pre-Feasibility Study No 10. 1991. Reduction of the environmental effects of the town of Petrozavosk. Plancenter LTD. 28 pp.

-"- Pre-Feasibility Study No 11. 1991. Reduction of the environmental effects of Segezha pulp and paper mill and Nadvoitsy aluminium factory. Plancenter LTD.

-"- Pre-Feasibility Study No 12. 1991. Reduction of the environmental effects of Pitkyaranta pulp and paper mill. Plancenter LTD. 5 pp.

-"- Pre-Feasibility Study No 13. 1991. Reduction of the environmental effects of the power plants in Narva. Plancenter LTD. 31 pp.

-"- Pre-Feasibility Study No 14. 1991. Reduction of the waste water load of the city of Tallinn. Plancenter LTD. 25 pp.

-"- Pre-Feasibility Study No 15. 1991. Reduction of the environmental effects in Kohtala-Järve district and Eesti Tsement. Plancenter LTD.

-"- Pre-Feasibility Study No 16. 1991. Reduction of the environmental effects of Kehra and Tallinn pulp and paper mills. Plancenter LTD.

2. WESTERN COAST OF ESTONIA

Plancenter Ltd, Swedish Environmental Research Institute (IVL), Swedish Meteorological and Hydrological Institute (SMHI), Ministry of the Environment of Estonia, 1992. Environmental Pre-Feasibility Study of the Western Coast of Estonia, Volume 1: Synthesis Report. 66 pp. (mimeogr.)

Plancenter Ltd, Swedish Environmental Research Institute (IVL), Swedish Meteorological and Hydrological Institute (SMHI), Ministry of the Environment of Estonia, 1992. Environmental Pre-Feasibility Study of the Western Coast of Estonia, Volume 2: Technical Report. 157 pp. (mimeogr.)

Plancenter Ltd, Ministry oe the Environment of Estonia, Ekono Environmental Technology, 1992. Environmental Pre-Feasibility Study of the Western Coast of Estonia, Volume 3: Supplemental Environmental Studies in Estonia. 108 pp. (mimeogr.)

3. THE GULF OF RIGA AND THE DAUGAVA RIVER BASIN

Carl Bro a/s Consulting Engineers and Planners in cooperation with Latvian Republic Environmental Protection Committee (LREPC), Swedish Development Consulting Partners (SDCP), Swedish Environmental Research Institute (IVL), Swedish Meteorological & Hydrological Institute (SMHI), NLK-Celpap, 1992. Pre-Feasibility Study of the Gulf of Riga and the Daugava River Basin, Volume 1: Synthesis Report. 79 pp (mimeogr.)

Carl Bro a/s Consulting Engineers and Planners in cooperation with Latvian Republic Environmental Protection Committee (LREPC), Swedish Development Consulting Partners (SDCP), Swedish Environmental Research Institute (IVL), Swedish Meteorological & Hydrological Institute (SMHI), NLK-Celpap, 1992. Pre-Feasibility Study of the Gulf of Riga and the Daugava River Basin, Volume 2: Technical Report, 99 pp. (mimeogr.)

4. LITHUANIAN COAST AND THE NEMUNAS RIVER BASIN

K-Konsult, Water Projects Ab in Joint Venture with I. Krüger Consult AS, ÅF-IPK AB, MFG Environmental Research Group, National Bacteriological Laboratory, Rambøll & Hannemann A/S, Water Quality Institute, Lithuanian Republic Environmental Protection Department, Pramproject, University of Klaipeda, 1992. Pre-Feasibility Study of the Lithuanian Coast and the Nemunas River Basin, Synthesis Report. 109 pp. (mimeogr.)

K-Konsult, Water Projects Ab in Joint Venture with I. Krüger Consult AS, ÅF-IPK AB, MFG Environmental Research Group, National Bacteriological Laboratory, Rambøll & Hannemann A/S, Water Quality Institute, Lithuanian Republic Environmental Protection Department, Pramproject, University of Klaipeda, 1992. Pre-Feasibility Study of the Lithuanian Coast and the Nemunas River Basin, Technical Report. 180 pp. (mimeogr.)

5. KALININGRAD REGION AND THE PREGEL RIVER BASIN

Norconsult International A.S. in joint Venture with Jaakko Pöyry, 1992. Pre-Feasibility Study of the Kaliningrad Region and the Pregel River Basin, Synthesis Report. (mimeogr.)

Norconsult International A.S. in joint Venture with Jaakko Pöyry, 1992. Pre-Feasibility Study of the Kaliningrad Region and the Pregel River Basin, Technical Report. (mimeogr.)

6. VISTULA RIVER BASIN AND BALTIC COAST OF POLAND

Sweco, COWIconsult, VKI in association with Hydroprojekt and Stolica, 1992. Pre-Feasibility Study of the Vistula River Basin and Baltic Coast of Poland, Part I, Synthesis Report. (mimeogr.)

Sweco, COWIconsult, VKI in association with Hydroprojekt and Stolica, 1992. Pre-Feasibility Study of the Vistula River Basin and Baltic Coast of Poland, Part II A, Technical Report. (mimeogr.)

Sweco, COWIconsult, VKI in association with Hydroprojekt and Stolica, 1992. Pre-Feasibility Study of the Vistula River Basin and Baltic Coast of Poland, Part II B, Technical Report. (mimeogr.)

7. ODER/ODRA RIVER BASIN

BCEOM, French Engineering Consultants with Sage Services, Sogreah, IMGW, Prosan, Lahmeyer International, T.G.M. WRI, 1992. Pre-Feasibility Study of the Oder/Odra River Basin, Executive Summary & Summary of Contens in Polish, Czech, Slovak and German. (mimeogr.)

BCEOM, French Engineering Consultants with Sage Services, Sogreah, IMGW, Prosan, Lahmeyer International, T.G.M. WRI, 1992. Pre-Feasibility Study of the Oder/Odra River Basin, Synthesis Report. 153 pp. (mimeogr.)

BCEOM, French Engineering Consultants with Sage Services, Sogreah, IMGW, Prosan, Lahmeyer International, T.G.M. WRI, 1992. Pre-Feasibility Study of the Oder/Odra River Basin, Technical Report 1; Point Pollution Sources - Industries. 198 pp. (mimeogr.)

BCEOM, French Engineering Consultants with Sage Services, Sogreah, IMGW, Prosan, Lahmeyer International, T.G.M. WRI, 1992. Pre-Feasibility Study of the Oder/Odra River Basin, Technical Report 2; Point Pollution Sources, Municipalities. 217 pp. (mimeogr.)

BCEOM, French Engineering Consultants with Sage Services, Sogreah, IMGW, Prosan, Lahmeyer International, T.G.M. WRI, 1992. Pre-Feasibility Study of the Oder/Odra River Basin, Technical Report 3; Non Point Pollution Sources. 84 pp. (mimeogr.)

BCEOM, French Engineering Consultants with Sage Services, Sogreah, IMGW, Prosan, Lahmeyer International, T.G.M. WRI, 1992. Pre-Feasibility Study of the Oder/Odra River Basin, Technical Report 4; Institutional and Environmental Impact Assessment. 192 pp. (mimeogr.)

8. NORTH GERMAN BALTIC COAST

Lahmeyer International, 1993. Feasibility Study of Measures to Reduce Pollution Loads in the Baltic Sea, Final Report. (mimeogr.)

TOPICAL AREA STUDIES

Norwegian Institute for Air Research, NILU, Jozef M. Pacyna (ed.), 1992. The Topical Area Study for Atmospheric Deposition of Pollutants, Final Synthesis Report. 41 pp. (mimeogr.)

Norwegian Institute for Air Research, NILU, Jozef M. Pacyna (ed.), 1992. The Topical Area Study for Atmospheric Deposition of Pollutants, Final Technical Report. 141 pp. (mimeogr.)

Norwegian Institute for Water Research, NIVA, 1992. Topical Area Study for Agricultural Runoff,Final Synthesis Report. 75 pp. (mimeogr.)

Norwegian Institute for Water Research, NIVA, 1992. Topical Area Study for Agricultural Runoff, Final Technical Report. 96 pp. (mimeogr.)

World Wide Fund for Nature, WWF, 1991. Wetlands-Vital Ecosystems for Nature and Societies in the Baltic Sea Region. 114 pp. (mimeogr.)

BALTIC SEA ENVIRONMENT PROCEEDINGS

No. 1 JOINT ACTIVITIES OF THE BALTIC SEA STATES WITHIN THE FRAMEWORK OF THE CONVENTION ON THE PROTECTION OF THE MARINE ENVIRONMENT OF THE BALTIC SEA AREA 1974-1978
(1979)*

No. 2 REPORT OF THE INTERIM COMMISSION (IC) TO THE BALTIC MARINE ENVIRONMENT PROTECTION COMMISSION
(1981)*

No. 3 ACTIVITIES OF THE COMMISSION 1980
- Report on the activities of the Baltic Marine Environment Protection Commission during 1980
- HELCOM Recommendations passed during 1980
(1981)*

No. 4 BALTIC MARINE ENVIRONMENT BIBLIOGRAPHY 1970-1979
(1981)*

No. 5A ASSESSMENT OF THE EFFECTS OF POLLUTION ON THE NATURAL RESOURCES OF THE BALTIC SEA, 1980
PART A-1: OVERALL CONCLUSIONS
(1981)*

No. 5B ASSESSMENT OF THE EFFECTS OF POLLUTION ON THE NATURAL RESOURCES OF THE BALTIC SEA, 1980
PART A-1: OVERALL CONCLUSIONS
PART A-2: SUMMARY OF RESULTS
PART B: SCIENTIFIC MATERIAL
(1981)

No. 6 WORKSHOP ON THE ANALYSIS OF HYDROCARBONS IN SEAWATER
Institut für Meereskunde an der Universität Kiel, Department of Marine Chemistry, March 23 - April 3, 1981
(1982)

No. 7 ACTIVITIES OF THE COMMISSION 1981
- Report of the activities of the Baltic Marine Environment Protection Commission during 1981 including the Third Meeting of the Commission held in Helsinki 16-19 February 1982
- HELCOM Recommendations passed during 1981 and 1982
(1982)

No. 8 ACTIVITIES OF THE COMMISSION 1982
- Report of the activities of the Baltic Marine Environment Protection Commission during 1982 including the Fourth Meeting of the Commission held in Helsinki 1-3 February 1983
- HELCOM Recommendations passed during 1982 and 1983
(1983)

No. 9 SECOND BIOLOGICAL INTERCALIBRATION WORKSHOP
Marine Pollution Laboratory and Marine Division of the National Agency of Environmental Protection, Denmark, August 17-20, 1982, Rønne, Denmark
(1983)

---
* out of print

No. 10 TEN YEARS AFTER THE SIGNING OF THE HELSINKI CONVENTION
National Statements by the Contracting Parties on the Achievements in Implementing the Goals of the Convention on the Protection of the Marine Environment of the Baltic Sea Area
(1984)

No. 11 STUDIES ON SHIP CASUALTIES IN THE BALTIC SEA 1979-1981
Helsinki University of Technology, Ship Hydrodynamics Laboratory, Otaniemi, Finland
P. Tuovinen, V. Kostilainen and A. Hämäläinen
(1984)

No. 12 GUIDELINES FOR THE BALTIC MONITORING PROGRAMME FOR THE SECOND STAGE
(1984)

No. 13 ACTIVITIES OF THE COMMISSION 1983
- Report of the activities of the Baltic Marine Environment Protection Commission during 1983 including the Fifth Meeting of the Commission held in Helsinki 13-16 March 1984
- HELCOM Recommendations passed during 1983 and 1984
(1984)

No. 14 SEMINAR ON REVIEW OF PROGRESS MADE IN WATER PROTECTION MEASURES
17-21 October 1983, Espoo, Finland
(1985)

No. 15 ACTIVITIES OF THE COMMISSION 1984
- Report of the activities of the Baltic Marine Environment Protection Commission during 1984 including the Sixth Meeting of the Commission held in Helsinki 12-15 March 1985
- HELCOM Recommendations passed during 1984 and 1985
(1985)

No. 16 WATER BALANCE OF THE BALTIC SEA
A Regional Cooperation Project of the Baltic Sea States;
International Summary Report
(1986)

No. 17A FIRST PERIODIC ASSESSMENT OF THE STATE OF THE MARINE ENVIRONMENT OF THE BALTIC SEA AREA, 1980-1985; GENERAL CONCLUSIONS
(1986)

No. 17B FIRST PERIODIC ASSESSMENT OF THE STATE OF THE MARINE ENVIRONMENT OF THE BALTIC SEA AREA, 1980-1985; BACKGROUND DOCUMENT
(1987)

No. 18 ACTIVITIES OF THE COMMISSION 1985
- Report of the activities of the Baltic Marine Environment Protection Commission during 1985 including the Seventh Meeting of the Commission held in Helsinki 11-14 February 1986
- HELCOM Recommendations passed during 1986
(1986)*

No. 19 BALTIC SEA MONITORING SYMPOSIUM
Tallinn, USSR, 10-15 March 1986
(1986)

No. 20 FIRST BALTIC SEA POLLUTION LOAD COMPILATION
(1987)

---
* out of print

No. 21 SEMINAR ON REGULATIONS CONTAINED IN ANNEX II OF MARPOL 73/78 AND REGULATION 5 OF ANNEX IV OF THE HELSINKI CONVENTION
National Swedish Administration of Shipping and Navigation;
17-18 November 1986, Norrköping, Sweden
(1987)

No. 22 SEMINAR ON OIL POLLUTION QUESTIONS
19-20 November 1986, Norrköping, Sweden
(1987)

No. 23 ACTIVITIES OF THE COMMISSION 1986
- Report on the activities of the Baltic Marine Environment Protection Commission during 1986 including the Eighth Meeting of the Commission held in Helsinki 24-27 February 1987
- HELCOM Recommendations passed during 1987
(1987)*

No. 24 PROGRESS REPORTS ON CADMIUM, MERCURY, COPPER AND ZINC
(1987)

No. 25 SEMINAR ON WASTEWATER TREATMENT IN URBAN AREAS
7-9 September 1986, Visby, Sweden
(1987)

No. 26 ACTIVITIES OF THE COMMISSION 1987
- Report on the activities of the Baltic Marine Environment Protection Commission during 1987 including the Ninth Meeting of the Commission held in Helsinki 15-19 February 1988
- HELCOM Recommendations passed during 1988
(1988)

No. 27A GUIDELINES FOR THE BALTIC MONITORING PROGRAMME FOR THE THIRD STAGE; PART A. INTRODUCTORY CHAPTERS
(1988)

No. 27B GUIDELINES FOR THE BALTIC MONITORING PROGRAMME FOR THE THIRD STAGE; PART B. PHYSICAL AND CHEMICAL DETERMINANDS IN SEA WATER
(1988)

No. 27C GUIDELINES FOR THE BALTIC MONITORING PROGRAMME FOR THE THIRD STAGE; PART C. HARMFUL SUBSTANCES IN BIOTA AND SEDIMENTS
(1988)

No. 27D GUIDELINES FOR THE BALTIC MONITORING PROGRAMME FOR THE THIRD STAGE; PART D. BIOLOGICAL DETERMINANDS
(1988)

No. 28 RECEPTION OF WASTES FROM SHIPS IN THE BALTIC SEA AREA
- A MARPOL 73/78 SPECIAL AREA
(1989)

No. 29 ACTIVITIES OF THE COMMISSION 1988
- Report on the activities of the Baltic Marine Environment Protection Commission during 1988 including the Tenth Meeting of the Commission held in Helsinki 14-17 February 1989
- HELCOM Recommendations passed during 1989
(1989)

---
* out of print

No. 30 SECOND SEMINAR ON WASTEWATER TREATMENT IN URBAN AREAS
6-8 September 1987, Visby, Sweden
(1989)

No. 31 THREE YEARS OBSERVATIONS OF THE LEVELS OF SOME RADIONUCLIDES IN THE BALTIC SEA AFTER THE CHERNOBYL ACCIDENT
Seminar on Radionuclides in the Baltic Sea
29 May 1989, Rostock-Warnemünde, German Democratic Republic
(1989)

No. 32 DEPOSITION OF AIRBORNE POLLUTANTS TO THE BALTIC SEA AREA 1983-1985 AND 1986
(1989)

No. 33 ACTIVITIES OF THE COMMISSION 1989
- Report on the activities of the Baltic Marine Environment Protection Commission during 1989 including the Eleventh Meeting of the Commission held in Helsinki 13-16 February 1990
- HELCOM Recommendations passed during 1990
(1990)*

No. 34 STUDY OF THE RISK FOR ACCIDENTS AND THE RELATED ENVIRONMENTAL HAZARDS FROM THE TRANSPORTATION OF CHEMICALS BY TANKERS IN THE BALTIC SEA AREA
(1990)

No. 35A SECOND PERIODIC ASSESSMENT OF THE STATE OF THE MARINE ENVIRONMENT OF THE BALTIC SEA, 1984-1988; GENERAL CONCLUSIONS
(1990)

No. 35B SECOND PERIODIC ASSESSMENT OF THE STATE OF THE MARINE ENVIRONMENT OF THE BALTIC SEA, 1984-1988; BACKGROUND DOCUMENT
(1990)

No. 36 SEMINAR ON NUTRIENTS REMOVAL FROM MUNICIPAL WASTE WATER
4-6 September 1989, Tampere, Finland
(1990)

No. 37 ACTIVITIES OF THE COMMISSION 1990
- Report on the activities of the Baltic Marine Environment Protection Commission during 1990 including the Twelfth Meeting of the Commission held in Helsinki 19-22 February 1991
- HELCOM Recommendations passed during 1991
(1991)

No. 38 THIRD BIOLOGICAL INTERCALIBRATION WORKSHOP
27-31 August 1990, Visby, Sweden
(1991)

No. 39 AIRBORNE POLLUTION LOAD TO THE BALTIC SEA 1986-1990
(1991)

No. 40 INTERIM REPORT ON THE STATE OF THE COASTAL WATERS OF THE BALTIC SEA
(1991)

No. 41 INTERCALIBRATIONS AND INTERCOMPARISONS OF THE COASTAL WATERS OF THE BALTIC SEA
(1992)

---
* out of print

No. 42 ACTIVITIES OF THE COMMISSION 1991
- Report of the activities of the Baltic Marine Environment Protection Commission during 1991 including the 13th meeting of the Commission held in Helsinki 3-7 February 1992
- HELCOM Recommendations passed during 1992
(1992)

No. 43 BALTIC MARINE ENVIRONMENT BIBLIOGRAPHY 1986-1990
(1992)

No. 44 NITROGEN AND AGRICULTURE, INTERNATIONAL WORKSHOP
9-12 April 1991, Schleswig, Germany
(1993)

No. 45 SECOND BALTIC SEA POLLUTION LOAD COMPILATION
(1993) **

---
* out of print
** in print

HELSINKI COMMISSION
Baltic Marine Environment Protection Commission

Katajanokanlaituri 6 B
FIN-00160 Helsinki
Finland

ISSN 0357-2994