PN-ACC-223
97002

Wastewater Project Analysis With Recommendations for The Municipality of Namysłów, Poland

Local Environmental Management (LEM) Project

April 1994

Prepared by:
Research Triangle Institute (RTI)
Research Triangle Park, NC 27709

Funded by:
U.S. Agency for International Development
Washington, DC 20523
Contract No. EUR-0039-C-00-2065-00

WASTEWATER PROJECT ANALYSIS WITH RECOMMENDATIONS

FOR

THE MUNICIPALITY OF NAMYSŁÓW, POLAND

LOCAL ENVIRONMENTAL MANAGEMENT (LEM) PROJECT

Prepared by:
Research Triangle Institute (RTI)
Research Triangle Park, NC 27709

Funded by:
U.S. Agency for International Development
Washington, DC 20523
Contract No. EUR-0039-C-00-2065-00

April 1994

Preserving Namysłów's scenic
and natural beauty as shown on the cover
is the objective of projects
like the waste water improvement effort
analyzed in this report.

TABLE OF CONTENTS

Section		Page
Tables		vii
Figures		ix
Abbreviations		xi
Executive Summary		xiii
1	INTRODUCTION	1
1.1	Namysłów Survey Objectives and Findings	1
1.2	LEM Project Overview	3
1.3	Profile of Namysłów	4
1.4	Survey Methodology	4
1.5	Survey Team Profile	8
2	TECHNICAL ANALYSIS	9
2.1	Existing Conditions	9
2.2	Main Sewage Treatment Plant, Namysłów	13
2.2.1	Background	13
2.2.2	LEM Recommendations for the STP	14
2.3	Problems and Recommendations for the ZPZ Potato Processing Factory	20
2.3.1	Background	20
2.3.2	Current Wastewater Management	21
2.3.3	LEM Recommendations for ZPZ	23
2.3.4	Comparison of Options for Disposal of ZPZ Wastewater	30
2.4	The Problem of Wastewater Treatment in the Gmina's Villages and Small Industries	32
2.4.1	Domestic Sewage Treatment in the Villages	32
2.4.2	Rural Industry in the Gmina	34
2.5	Contribution of Proposed Project in Improving Health Conditions	35
3	MANAGEMENT ANALYSIS	39
3.1	Organization and Management of the Municipality	39
3.1.1	Legal Basis	39
3.1.2	Management	39
3.1.3	Relationship with Other Levels of Government	41
3.1.4	Classification of Gmina Organizational Units by Budget Type	47
3.2	Organization, Management, and Administration of Potable Water and Wastewater Operations	48
3.2.1	Legal Basis of the Namysłów Water Company	48
3.2.2	Management Structure of the NWC	49
3.2.3	Financial Management Analysis	53
3.3	Overall Management Assessment	54
3.3.1	Efficiency and Effectiveness in Municipal Management	54

3.3.2 Efficiency and Effectiveness in Water and Wastewater Management . . . 58
3.4 Recommendations . . . 59
3.4.1 Short-Term Recommendations: 6 to 12 months, for NWC . . . 59
3.4.2 Short-Term Recommendations: 6 to 12 months, for Gmina . . . 61
3.4.3 Longer-Term Recommendations . . . 62

4 FINANCIAL ANALYSIS . . . 67
4.1 Gmina Economic Conditions . . . 67
4.2 Gmina Budgeting and Finance . . . 69
4.2.1 Background . . . 69
4.2.2 Budget and Allocation Processes . . . 70
4.2.3 Gmina Budget . . . 71
4.2.4 Intergovernmental Finances . . . 82
4.3 Namysłów Water Company . . . 82
4.3.1 Current Services . . . 82
4.3.2 Rate Structure . . . 82
4.4 New Sewage Treatment Plant . . . 88
4.4.1 Capital Costs . . . 88
4.4.2 Financing . . . 88
4.4.3 Additional Operating Costs of the Plant . . . 90
4.4.4 Projections of Cost . . . 91
4.4.5 Fiscal/Financial Burden . . . 91
4.5 Affordability of Sewer and Water Rates . . . 95
4.6 Gmina-Proposed Environmental Projects . . . 96
4.7 Operating Costs . . . 98
4.8 Financing Sources . . . 98
4.8.1 Internal Sources of Finance . . . 99
4.8.2 External Sources of Finance . . . 100
4.8.3 Cost Comparison . . . 101
4.9 Financial Assessment . . . 103
4.9.1 Refinancing . . . 103
4.9.2 Potato Factory Wastewater Treatment Plant . . . 103
4.9.3 Wastewater Treatment for Villages . . . 108
4.9.4 Wastewater Pretreatment for Rural Industries . . . 108
4.10 Summary of Financial Recommendations . . . 108
4.10.1 Economic Conditions . . . 108
4.10.2 Gmina Budget . . . 109
4.10.3 New Sewage Treatment Plant . . . 109
4.10.4 Namysłów Water Company . . . 110
4.10.5 New Investments . . . 110

5 RECOMMENDATIONS FOR ADDITIONAL TECHNICAL ASSISTANCE AND TRAINING . . . 111
5.1 Recommendations for Additional LEM Technical Assistance . . . 111
5.1.1 Overall Recommendations - Whole Gmina . . . 111
5.1.2 Assistance on Main STP . . . 113

5.2 Management 114
5.3 Finance 115
5.4 Training and Outreach Recommendations 116
5.4.1 Training Specific to Namysłów 116
5.4.2 Training Course for Treatment Plant Operators 117
5.4.3 Training in Management and Operations of Water and Wastewater Organizations 118
5.4.4 Financial Administration of Water/Wastewater Organizations 118
5.4.5 Planning for Water/Wastewater Management 118
5.4.6 Developing and Writing a Project Business Plan 119
5.4.7 Management of Infrastructure Projects 119
5.4.8 Design and Implementation of Public Information Programs on the Environment 119

Appendix

A Photographs
B Detailed Calculations by LEM:
Raw Wastewater Balance (including all industries)
Process for Biological Nitrogen and Phosphorus Removal
C Critique of Hydrosan Design for the Municipal Sewage Treatment Plant
D Cost Calculations for Three Solutions to the Problem of Wastewater from the ZPZ Potato Processing Plant

TABLES

Number		Page
2.1	Comparison of Options for Treatment of ZPZ Wastewater	30
3.1	Characterization of Budgetary Units by Function Performed	44
4.1	Economic and Statistical Information	68
4.2	Namysłów Budget for 1991-1993: Revenues and Expenditures	72
4.3	Gmina Revenues, Expenditures, and Investments, 1991-1993	73
4.4	Percentage Breakdown, Revenues and Expenditures, 1991-1993	77
4.5	Analysis of Fees and Budget and Environmental Expenditures	81
4.6	Analysis of Financial Information for Namysłów Water Supply System	84
4.7	Sample Revenue Calculations for Sewer and Water for the Namysłów Water Company	86
4.8	Financing Plans for the Sewage Treatment Plant	89
4.9	Analysis of Loans for Sewage Treatment Plant from National Environmental Funds and Voivodship Environmental Fund	92
4.10	Analysis of Sewage Treatment Plant Total Costs for Gmina and Water Company	93
4.11	Affordability Study: per capita Calculations	97
4.12	Estimated Project Costs	97
4.13	Cost Comparison of Alternative Funding Sources	102
4.14	Analysis of Loans for Potato Factory	105
4.15	Analysis of Affordability of Potato Factory Loans	106

FIGURES

Number		Page
1.1	Map of the Opole Voivodship	5
1.2	Map of the Gmina of Namysłów	6
1.3	Map of the Regional Water Management Authority (Wrocław)	7
2.1	Map of the city of Namysłów, with industry and water/sewer facilities	10
2.2	Namysłów sewage treatment plant before upgrading	12
2.3	Schematic of the new sewage treatment plant proposed by Hydrosan	15
2.4	LEM proposal: Elimination of the brewery treatment plant and solution of the sludge processing train, Namysłów STP	16
2.5	Schematic of the LEM proposal for improvements to the new STP	18
2.6	Present waste treatment at the ZPZ potato processing plant	22
2.7	ZPZ wastewater treatment Option 1 — Combined treatment at the municipal STP ("unlimited funds" solution)	24
2.8	LEM proposal: ZPZ wastewater treatment, Option 3 — separate anaerobic-aerobic reactors	29
2.9	LEM proposal: Treatment plant for a rural distillery	36
3.1	Organizational diagram of the Namysłów City Office	42
3.2	Management structure of the Namysłów Water Company	51
3.3	Staffing of the Namysłów Water Company	52
4.1	Diagram of Gmina Budget Process	71
4.2	Rate-Setting Process, Namysłów Water Company	83

ABBREVIATIONS

ATV	[set of standards used in Germany for waste treatment]
BNR	biological nutrient removal
BOD_5	biochemical oxygen demand (5-day test)
BPWM	Biuro Projektów Wodno-Melioracyjnych [Water and Irrigation Design Office]
COD	chemical oxygen demand
CSO	combined sewer overflow
DO	dissolved oxygen
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
ENR	Environmental and Natural Resources [Division, USAID]
EUR	Europe
GOP	Government of Poland
HRT	hydraulic residence time
IMUZ	Instytut Melioracji Użytków Zielonych [Institute for Agricultural Land Irrigation]
LEM	Local Environmental Management [project]
LSGA	Local Self-Government Act
MOF	Ministry of Finance
O&M	operations and maintenance
NBP	National Bank of Poland
NGO	nongovernmental organization
NWC	Namysłów Water Company [Wodociągi Namysłowskie]
PKO	Powszechna Kasa Oszczędności [Polish Savings Bank]
RAS	return activated sludge
RTI	Research Triangle Institute
RWMA	Regional Water Management Authority (Wrocław) [Regionalny Zarząd Gospodarki Wodnej (Wrocław), RZGW]
SANEPID	[Polish public health authority]
SBR	sequencing batch reactor
SS	suspended solids
STP	sewage treatment plant
UASB	upflow anaerobic sludge bed [reactor]
UCT	University of Cape Town, South Africa - author of the BNR process solution
USAID	U.S. Agency for International Development
WAS	waste activated sludge
ZGM	Zakład Gospodarki Mieszkaniowej w Namysłowie [housing authority]
ZPZ	Zakłady Przemyslu Ziemniaczanego [Potato Processing Plant]
ZUK	Zakład Usług Komunalnych Namysłów [solid waste authority]

November 1993 exchange rate:

US $1 = zł 20,000

EXECUTIVE SUMMARY

The need for improvements in environmental management in Central and Eastern Europe has gained the attention of development organizations worldwide in recent years. Furthermore, in light of the scarcity of resources at the national level, efforts to help local governments design and implement environmental projects have become increasingly important as development strategies. Through such assistance, municipalities can discern appropriate technologies, develop proposals for procuring funding, coordinate training for operation and management of new infrastructure, and design "outreach" programs that foster education and involvement of citizens. In addition, successful local environmental projects serve as models for other municipalities to follow in addressing their own environmental problems.

The Namysłów Wastewater Project Analysis is one of a series of studies of municipalities in Poland conducted under the auspices of USAID's Local Environmental Management (LEM) project. The objectives were to review Namysłów's wastewater problems and proposed solutions, and concurrently to review the organizational, management, and financial context in which the gmina is carrying out its environmental agenda. The project team assessed the gmina's need for further technical assistance and training, and offered practical recommendations that would be helpful in guiding the gmina's future actions.

The gmina of Namysłów (pop. 26,600) is located in the Opole voivodship in southwestern Poland. The central town, Namysłów (pop. 16,300), had long been served by a system in which sewage was collected from households and businesses and conveyed to a treatment plant adjacent to the Młynówka (Mill Creek). Primary effluent from the plant was pumped to infiltration lagoons and allowed to flow from there into open streams feeding into the Widawa river. However, the Widawa's water quality recently was targeted to be remediated to the highest category (i.e., fit for a municipal water supply). This designation made the cleanup of all major contributors to pollution of the Widawa a top priority. The gmina, therefore, commissioned the reconstruction of its existing plant to meet new standards, and has since benefitted from the decision of a German firm to locate a new ice cream plant in Namysłów as a result of its STP capacity.

Technical Review and Recommendations

Gmina official had requested that LEM review and advise on three wastewater issues: construction and operation of the new STP; treatment of industrial wastewater from a large potato processing plant; and planning for wastewater management in the gmina's rural industries and small villages.

Main Sewage Treatment Plant

At the time of the LEM visit in November 1993, the gmina had already made a significant investment in a new STP. The new STP, which will use the biological nutrient removal (BNR) treatment process, was 75% complete.

Originally this facility was to serve the city, the brewery, and the potato processing plant (ZPZ). However, because of financial difficulties ZPZ was unable to contribute its share, so plans for including the ZPZ wastewater were dropped from the project. To its credit, the gmina opted to continue the project anyway, taking on the added financial burden and authorizing the design firm to proceed with the revised plan. The resulting design incorporated the concept of constructing a sewer line from the brewery to the STP and a pretreatment facility at the sewage treatment plant dedicated to brewery wastewater at an estimated cost of zł 5.4 billion. During the LEM visit in November, technical analysis by the LEM project's engineer demonstrated that pre-treatment of the brewery's waste was not required to meet the standards for effluent set in the plant's permit. This suggestion will create savings of 5 billion zł. The necessity to build a compensation reservoir for brewery wastewater (as well as a separate pipeline to the STP) will be considered after startup of the STP, once observations of the first stage can be made. LEM has proposed changes in the design of the activated sludge chamber, and improvement of operations in the event of clarifier failure. Also LEM recommended aerobic (intermittent) sludge stabilization, gravity thickening, and dewatering using a portable gmina-owned facility that also could be employed at other plants in the area.

Potato Processing Plant

The ZPZ factory - viewed as an integral part of the gmina's economy, even though it was in receivership at the time of the LEM team's visit, processes potatoes into distilled spirits, dried potatoes, and starch. The factory discharges large amounts of wastewater, which receives rudimentary treatment at the plan and then is disposed by land application on a portion of the 131 ha of irrigation fields owned by the factory. This longstanding practice poses two problems: (1) the application dose practiced by ZPZ is well above any standard and (2) most of the land used by ZPZ lies above the aquifer that supplies almost two-thirds of Namysłów's water supply. The Namysłów Water Company (NWC), the gmina's limited-liability company, reports significant degradation of water supply from these wells during the plant's processing season.

The LEM team believes that the current land disposal practice is not acceptable and that immediate action is necessary to avoid the very real environmental and monetary cost of a polluted aquifer. Acknowledging that the extent of investment in a solution will depend on the financial future of the ZPZ factory, LEM has offered three possible approaches to the problem: pretreatment at ZPZ and disposal to the new STP; relocation of the irrigation fields and increase of acreage; or separate treatment of ZPZ waste and discharge to surface waters. A change in discharge permit status for the municipal STP to reflect the plant's heavy industrial (over 80%) - as opposed to domestic - load could reduce the cost of the first option by almost half, from zł 29 billion to zł 16 billion. Combined secondary treatment of waste will then be the best solution. The LEM project team strongly

recommends close ongoing consultation between gmina officials and ZPZ management/owners to find a resolution that meets both the gmina's environmental and its economic objectives.

Distilleries

In addition to the ZPZ distillery, there are three other distilleries located in small villages. The gmina considers them to have a slops disposal problem. For example, while slops could be a good additive to animal feed, reduced number of livestock have significantly curtailed this use. Further, the practice of land application via irrigation with slops is only effective during the growing season and can contribute to runoff problems. LEM team members observed slops dumped in land depressions, hidden in bushes, or combined with wastewater and dumped in a nearby creek.

The LEM team noted that the distilleries appear to be very profitable, such that development of formal treatment plants for each of the stand-alone distilleries would be financially feasible and would provide a permanent, year-round solution for distillery effluent. As a possible solution, a three-stage lagoon system was proposed, with the option of using a SBR as the second stage, and a polishing pond. Thus the problem of animal waste which is frequently combined with distillery waste would also be resolved.

Village Wastewater Treatment

In the 32 villages where 10,300 of Namysłów gmina's population reside, there are a variety of water and wastewater issues. These include the distillery waste in three villages, overloaded septic systems, and discharges near water sources.

In close collaboration with the NWC and other government agencies, the gmina is working to improve the quality and reliability of water service in villages by installing service where it does not exist, or improving it where systems have fallen into disrepair. These systems will be operated by the NWC and a uniform rate for water service will be charged in the villages.

Similarly, the gmina intends to improve the handling of sewage in the villages. The gmina has two objectives in this effort: (1) to protect village water supplies, and (2) to enhance environmental health. This effort is being carried out directly by the gmina rather than through the NWC. The LEM team suggests that the gmina review the study on sanitary services for villages which was prepared in 1988 and then develop a comprehensive plan that identifies the appropriate technology to meet the gmina's twin objectives in each village. The plan must address financing, O&M, and the feasibility of various options. In the villages of Minkowskie, Przeczów and Pawłowice, evaluation of joint approaches that could solve both the distillery and village problems are recommended. The gmina has already decided on an approach for Głuszyna, the largest village. The bid opening for a treatment system for Głuszyna took place during LEM's visit and resulted in the appropriate choice of a sequencing batch reactor and polishing pond. On the basis of the bid, LEM has formulated a number of suggestions concerning: the choice of process; methods of evaluationg offers; suitable and

unsuitable solutions from the economic and ecological angle; and simplifying the STP equipment operations.

Management Review and Recommendations

Overall, the Gmina of Namysłów has taken the delegation of responsibility to gminas very seriously, moving aggressively to improve the quality of service delivery and to make investments in its own future. The steps it has taken - selling publicly held assets and using them to make infrastructure improvements, moving toward more rational pricing of services, making use of private or quasi-public organization to deliver services wherever feasible - appear to be economically rational, designed to improve the quality of life, and likely to provide a basis for further economic development.

In the area of water of water and wastewater management, the water supply and distribution system is managed by a competent staff that has a long history with the system. The NWC, the gmina's corporate entity charged with managing critical parts of the gmina's infrastructure, will take over operation of the new STP and continue its regular day-to-day provision of water and sewer services.

The LEM management recommendations detailed below largely reflect the gmina's or the NWC's understandable inexperience with certain new responsibilities. For example, the overarching recommendation listed first - the need to conduct feasibility studies - seemed to be a relatively unfamiliar concept in the gmina, but is of paramount importance as the gmina moves forward with its environmental agenda and its infrastructure development program.

Feasibility Studies

For such projects as STP construction, wastewater management programs for the villages, treatment assistance for ZPZ, and other projects of similar scale, the gmina should complete a comprehensive feasibility study at the very beginning of the project development process.

LEM specifically recommends the feasibility study approach be used to (1) further evaluate the options for treating ZPZ wastewater as ZPZ's future becomes clearer and develop a comprehensive plan for wastewater management in the villages, incorporation the needs of the three village-based distilleries.

NWC Management

The LEM team's recommendations to the NWC/gmina, presented in Namysłów in late November, fall into two categories: sewage treatment plant operations and wastewater management in the villages.

Sewage Treatment Plant Operations

At the time of the LEM team's visit, despite the advanced stage of STP construction, the NWC did not have plans in place to hire a treatment plant superintendent, select and train operators, effectively estimate O&M costs, implement the rate changes needed, or carry our a public information program to educate the city residents about the plant. LEM recommends the following actions.

- Develop a job description for the plant supervisor that identifies the skills needed to operate a complex BNR plant, and commence an active search for candidates.
- Establish a rigorous recruitment, evaluation and hiring process for the staff of the new treatment plant, incorporating provisional hiring and training of internal candidates.
- Complete the O&M cost evaluation for the new STP. This would include the increased cost of labor, materials, and utilities, as well as sufficient reserves for contingencies that will arise as the plant goes through shakedown.
- Develop a program to train operators and key staff of the NWC in the technology of the nutrient removal process (see LEM training program proposals 5.4.2 p.117).
- Construct a small laboratory at the site of the STP so plant operations can perform the basic tests to analyze the plant's performance. This is essential for proper management of the STP.

Wastewater Management in the Villages

NWC management concerns in the villages center largely on the fact that no decision has been made on which organization will operate plants like the one in Głuszyna, or generate the revenue to support them; in fact, the staff of the NWC did not participate in the Głuszyna bid. The LEM-recommended comprehensive plan for village wastewater management, in addition to focusing on the protection of ground and surface water, environmental and public health, and aesthetics, should connect with the NWC's efforts to improve village water services. The plan also should:

- Be linked to the gmina's land use planning processes. Especially significant is the coordination with the revised land use plans solutions for animal waste disposal.
- Evaluate the capability of the new STP to process village septage and the potential consequences of continuing to dump septage into the existing lagoons.
- Evaluate how the gmina can use its land use regulatory powers and public health powers to solve problems identified in the plan, specifically, it should examine the gmina's powers to regulate land use, protect public health, and set standards for septage treatment and discharge. If these powers are inadequate, they should be strengthened.
- Evaluate the gmina's authority to require individual or communal participation in the new wastewater management systems. If these powers are inadequate, they should strengthened.

- Evaluate the most appropriate roles for the gmina and the NWC to play in the planning, design, and operation of village wastewater facilities.

Financial Review and Recommendations

Since 1991, according to the stipulations of local self-government laws passed by the national parliament, the gmina has assumed a significant number of new services and financial responsibilities. These new responsibilities have meant financial changes and opportunities for implementing environmental projects and services. In general, the gmina has adjusted well, having had budget surpluses for two of the past three years.

The Gmina has implemented new revenues and fees to meet its responsibilities in all areas, including the environment. It has sold assets to the private sector and reinvested these funds in public investments, particularly environmental projects; and also has generated grants and loans from higher levels of government to invest in such projects. An example is the new STP for which the gmina was able to raise the necessary capital funds, recognizing that it represented a significant financial investment and risk.

To provide environmental services as off-budget items with their own fees, revenue structures, and assets/liabilities, the gmina created several specialized municipal entities. For example, it established a water/sewer company, created an independent solid waste company, and is considering taking over the district heating system.

The NWC, a private company that is legally separate from the gmina, was established on sound financial principles. Its sewer and water rates, to the degree possible, are based on cost of service, although the NWC is still trying to reduce subsidies between rates. Excess cash that is generated is used to repair and replace current plant and equipment. An independent audit of the company was to be completed after the first 18 months of STP operation (March 1994). The key issue for the NWC will be maintaining its current momentum.

Key financial recommendations are:

- Develop a public information program to prepare citizens for a potential increase in rates. The Public education campaign should emphasize the benefits of the STP and its role in supporting investment and jobs, as well as the environmental benefits of the plant.

- Establish a program of annual audits by an outside firm that presents a complete financial picture of the gmina. The firm should have financial management systems expertise, and apply it to strengthen the gmina's management and control systems.

- Modernize government accounting and reporting procedures. In order to raise capital from banks and investors, the gmina needs to develop the capacity to present a complete financial picture of the gmina, including balance sheets and flow-of-funds statements.

- Establish the capability to refinance the STP. Refinancing would help reduce debt service payments and minimize the potential for rate shock. Seek an exemption from national taxes levied on the NWC. The chief disadvantage of using a limited-liability company to provide utility services is the requirement that the company pay national taxes. LEM recommends that Namysłów work with other gminas to submit a parliamentary act that would exempt from national taxation any public utility companies whose stock is held entirely by the gmina.

- Offer financial assistance to ZPZ-based **only** on a financial analysis of the full costs and benefits to the gmina. One option would be to provide any financial assistance in conjunction with restructuring of the company.

LEM Technical Assistance and Training

During the balance of LEM's project life, LEM is prepared to provide additional training and technical assistance to Namysłów and the NWC to support the implementation of recommendations in the report. Technical assistance could address issues specific to Namysłów (e.g., developing an operating guide/manual for the STP, developing a comprehensive wastewater management plan for the villages, reviewing STP startup, and assisting in securing an on-call expert in BNR). Training programs could be provided to staff in the five gminas participation in the LEM project, as well as to staff from other gminas. During the LEM team's visit, the Mayor of Namysłów expressed strong interest in training for gmina staff, especially in courses titled "Developing and Writing a Business Plan" and "Management of Infrastructure Projects".

Summary

Namysłów has moved rapidly to exercise the power devolved to local governments in 1990 and is aware of the need to invest in community infrastructure. Despite the critiques in this report, which the gmina and the NWC can overcome, the STP has already fulfilled one of its major objectives - supporting the gmina's efforts to attract new industry. In addition, the project management experience that the gmina has gained, coupled with followup LEM technical assistance and training, will help the gmina build on its successes, further strengthening Namysłów's capability to resolve complex environmental issues.

1 INTRODUCTION

1.1 Namysłów Survey Objectives and Findings

The Namysłów wastewater project analysis described in this report was designed to investigate three major areas: technical, financial and management. The *technical* aspect of the survey included a careful and detailed review of the gmina's present wastewater treatment problems, and proposed solutions. The survey team also performed a *management* analysis, focusing on the current organization and management of the municipality as well as its potable water and wastewater operations. The *financial* component of the survey consisted of a detailed exposition of the budget operation, the financial resources available to the gmina, and any plans for financing water/wastewater capital needs as well as operations and maintenance (O&M). Within these three areas, the team assessed the needs for further *technical assistance and training*, within the LEM mandate and project life, and supplied practical recommendations and conclusions that could serve as a guide for the gmina's present and future actions.

In the process of spelling out findings and recommendations for each of the three areas independently, the team also noted several concerns that affect all the areas of analysis.

First and foremost was the fact that insufficient advantage had been taken of the ***independent feasibility study*** process in order to find alternative solutions, which created a series of problems. For example, the technology chosen was far more sophisticated than may have been warranted. This choice escalated the construction costs and complicated operations and maintenance. On the management side, even at the 75% completion stage, no staffing plan for the new plant had been prepared; and although the gmina was successful in making financing arrangements (with the help of the designer), it remains to be seen how the public would react to the large step-up in rates that could be called for to cover the loan repayment and operating costs.

In light of Namysłów's experience, the LEM team determined that technical assistance is required to help gminas develop and manage comprehensive feasibility studies for wastewater treatment projects. Such studies would:

- define existing conditions and needs based on rigorous analysis of current and anticipated flows and treatment loads;
- identify the project management and the operational requirements for various technical alternatives, including temporary and permanent staffing, organizational and legal structure, and O&M costs associated with each alternative; and
- evaluate financing alternatives and affordability for each option.

Other ***limitations of the contract bid and procurement process*** as used in Namysłów are the assumptions it makes: (a) designers have a high level of experience, and (b) the gmina has access to the expertise and the information to adequately evaluate the submitted bids. The present design/build practice also creates a disincentive for the designer to minimize costs to the gmina. Areas where technical assistance could improve the bidding and evaluation process include procurement, design of contracts, and use of consultants.

Namysłów is facing the same problems of unemployment, falling prices for agricultural commodities, and inflation that are troubling other communities throughout Poland. Local governments have had to choose whether to allocate scarce funds to social services or to other public expenditures, leading in many cases to inadequate spending on infrastructure projects such as wastewater treatment. The LEM team acknowledges this ***difficult economic climate***, but also notes that Namysłów has seen a connection between creating adequate wastewater treatment capacity today and encouraging economic/industrial growth in the future.

Despite continuing economic difficulties both locally and throughout the country, the gmina has been progressive in naming its environmental priorities and aggressive in seeking out technical solutions and funding for them. Nevertheless, the LEM team sees a need for a more ***coordinated approach to environmental problems.*** For instance, the gmina, the Regional Water Management Authority (Wrocław), and possibly the voivodship will need to clarify what agencies are responsible for addressing problems that cross jurisdictions, such as monitoring agricultural runoff, household septage systems, or land disposal of sludge and slops. Another example would be a comprehensive plan for village sewage problems, village water supply, and wellhead protection.

Although the gmina successfully put in place the institutional arrangements for managing the city's water and wastewater services by combining public control over policy with private sector management, questions remain about the ***division of responsibilities*** between the gmina and the Namysłów Water Company. This ambiguity means, for example, that the Water Company has largely been left out of the planning, procurement, and management of the proposed village wastewater treatment systems. In addition, it has not been determined whether the Water Company or the gmina ultimately will be responsible for the considerable debt service payments and operating costs of the new main treatment plant.

Other findings specific to the technical, management, or financial analyses appear in those respective chapters of the report and in the appendices. Recommendations for LEM-based technical assistance and training are in Chapter 5.

1.2 LEM Project Overview

Local Environmental Management (LEM) is a project of the United States Agency for International Development (USAID)/Washington based on a contract between Research Triangle Institute (RTI) and the USAID/Europe (EUR) Environmental and Natural Resources (ENR) Division. The contract is for 3 years, beginning in July 1992 and ending in July 1995.

Originally the LEM project began as a USAID effort to coordinate and/or operate through a variety of environmental projects at the subnational/local level throughout most of the countries of Central and Eastern Europe; however, USAID program reconsideration narrowed the project focus. RTI and USAID/EUR/ENR agreed to focus LEM on specific municipal government environmental projects in Poland and Hungary.

RTI undertook preliminary field trips to Poland in September and November 1992, which included members of RTI, USAID/ENR, USAID's Office of Housing and Urban Programs, and the USAID Representative's Office in Poland. These field trips confirmed the need and importance of working with "local" environmental projects as well as the necessity of narrowing the focus to four or five municipalities and establishing a set of criteria for setting both the project focus and the choice of specific municipalities to be included in LEM.

The LEM project purpose in Poland is threefold: (1) to demonstrate the extent to which local governments can effectively manage their environmental problems if given adequate and consistent support; (2) to assist project municipalities, or gminas, in producing reliable and technically acceptable proposals for the funding of environmental projects for presentation to national and international funding agencies; and (3) to make available for use to other municipalities the replicable details as a result of the former two activities. A project subpurpose is to act as liaison by matching municipal requests for technical assistance not supplied by LEM with various USAID-supported projects that may be able to provide information, data, or assistance.

The overall strategy is to implement project activities in a set of five municipalities in Poland, with each activity focusing on specific aspects of wastewater treatment. The five municipalities and their respective populations are:

Municipality	Population
Miedźna	14,500
Święta Katarzyna	12,000
Ziębice	20,400
Nowa Sól	43,000
Namysłów	26,600

1.3 Profile of Namysłów

The gmina[1] of Namysłów has a population of 26,600 people in an area of 290 square kilometers in Opole voivodship (see maps, Figures 1.1 and 1.2). It is located on the Widawa River, a tributary of the Odra. Namysłów is also within the purview of the Regional Water Management Authority (Wrocław) regarding water and wastewater activities (Figure 1.3). The main town, Namysłów, contains about 16,300 people, while the remaining 10,300 are spread among 32 villages. Nearly half of the villages have their own water supply.

The gmina's most pressing environmental and health problem is wastewater treatment (a) in the main town and (b) in the villages. Namysłów focused on Głuszyna as its first effort at serving the villages. The gmina had received quotations for a lagoon-type system, but the bid evaluators made use of technical advisement from the LEM team and selected a sequencing batch reactor system instead.

At the same time, the municipal wastewater treatment plant in the main town of Namysłów is being reconstructed and modernized in order to increase its capacity and improve the level of treatment to meet new requirements. The town also is concerned about a large potato processing factory's negative effect on the groundwater supply, plus the effects of potential expansion of the new ice cream plant on local wastewater treatment capacity.

1.4 Survey Methodology

Under the direction of the LEM Project Manager, team members met with local officials in Namysłów to gather technical, organizational, and financial data regarding the current wastewater situation. Before departure from Poland, the team orally presented its recommendations to Namysłów officials in order to solicit feedback and prepared a draft report for eventual translation into Polish and submission to the gmina. The Namysłów report, as well as the report from the Nowa Sól activity, will provide "baseline" data for a regional planning workshop to be held in Poland in March 1994. At that time, a full discussion of each draft report will take place for making additions, corrections, or changes; future needs for technical assistance and training to the end of the LEM project also will be assessed.

[1]The term "gmina" refers to the entire group of villages within a geographical area, similar to the concept of a township in the US or a commune in France. The word "town" or "city" designates a particular village or settlement, usually more populated or industrialized, that acts as the economic center of the gmina. Hence, the town/city of Namysłów is the more densely populated center of gmina Namysłów.

OPOLE

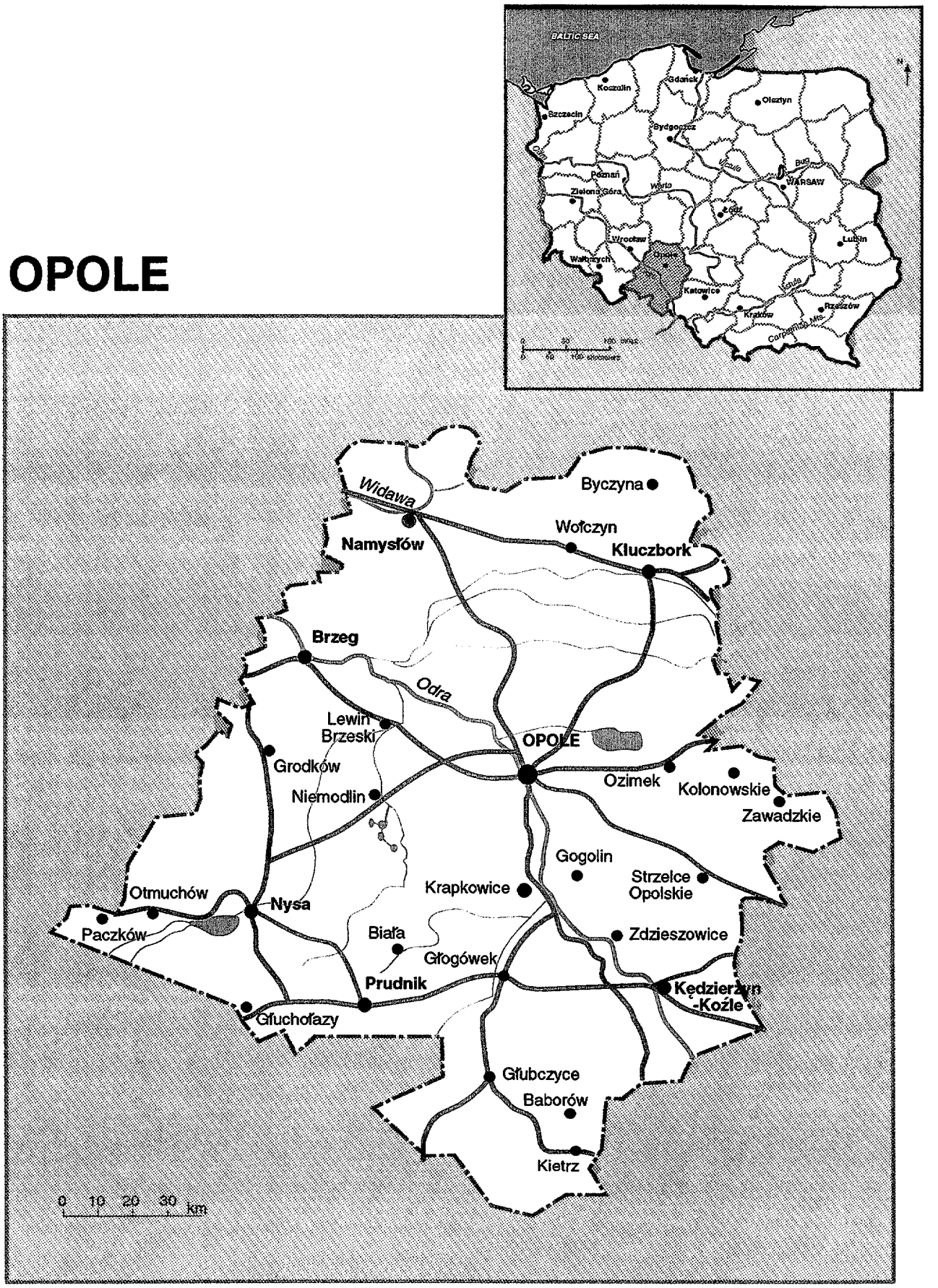


Figure 1.1 Map of the Opole Voivodship

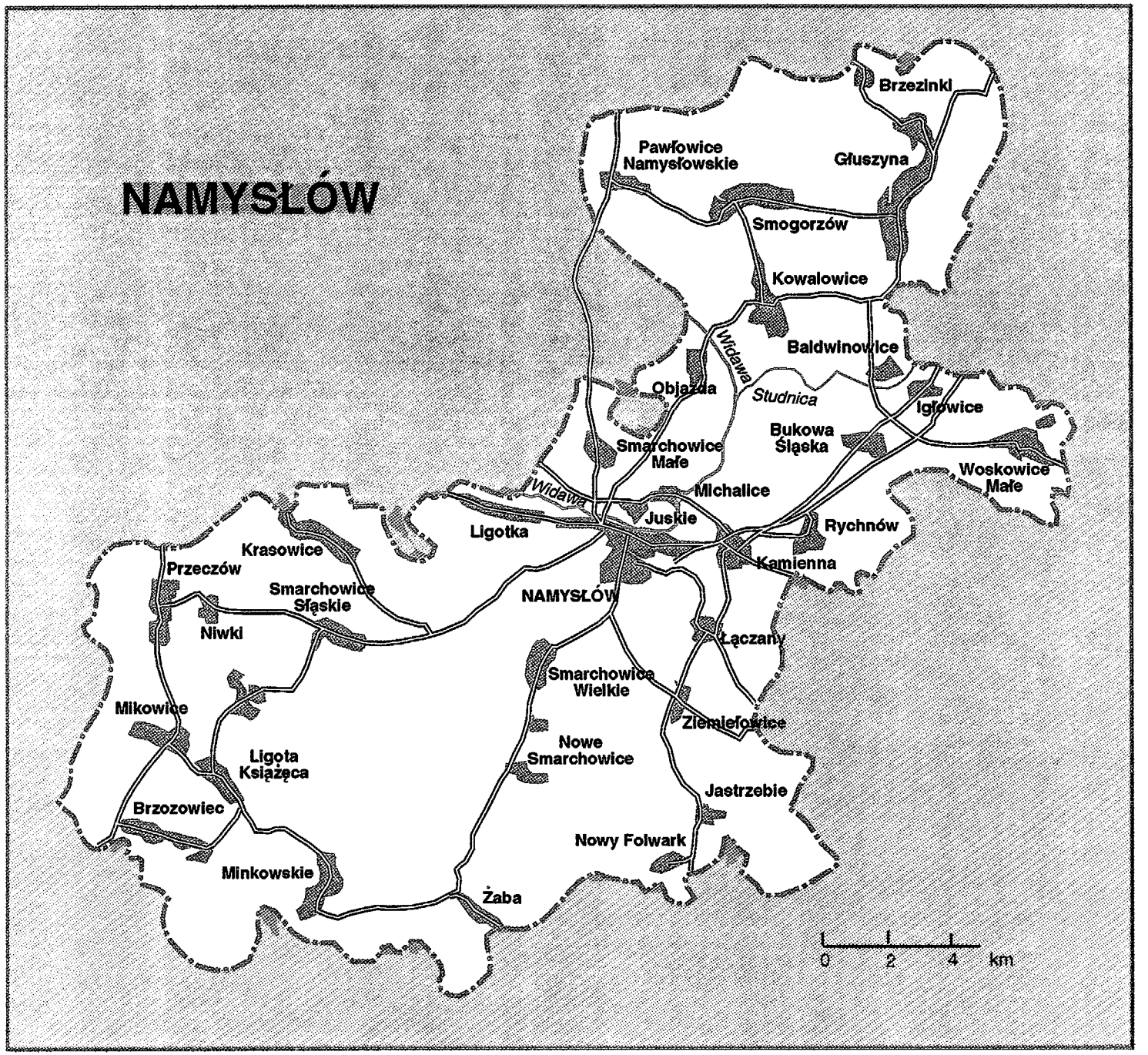
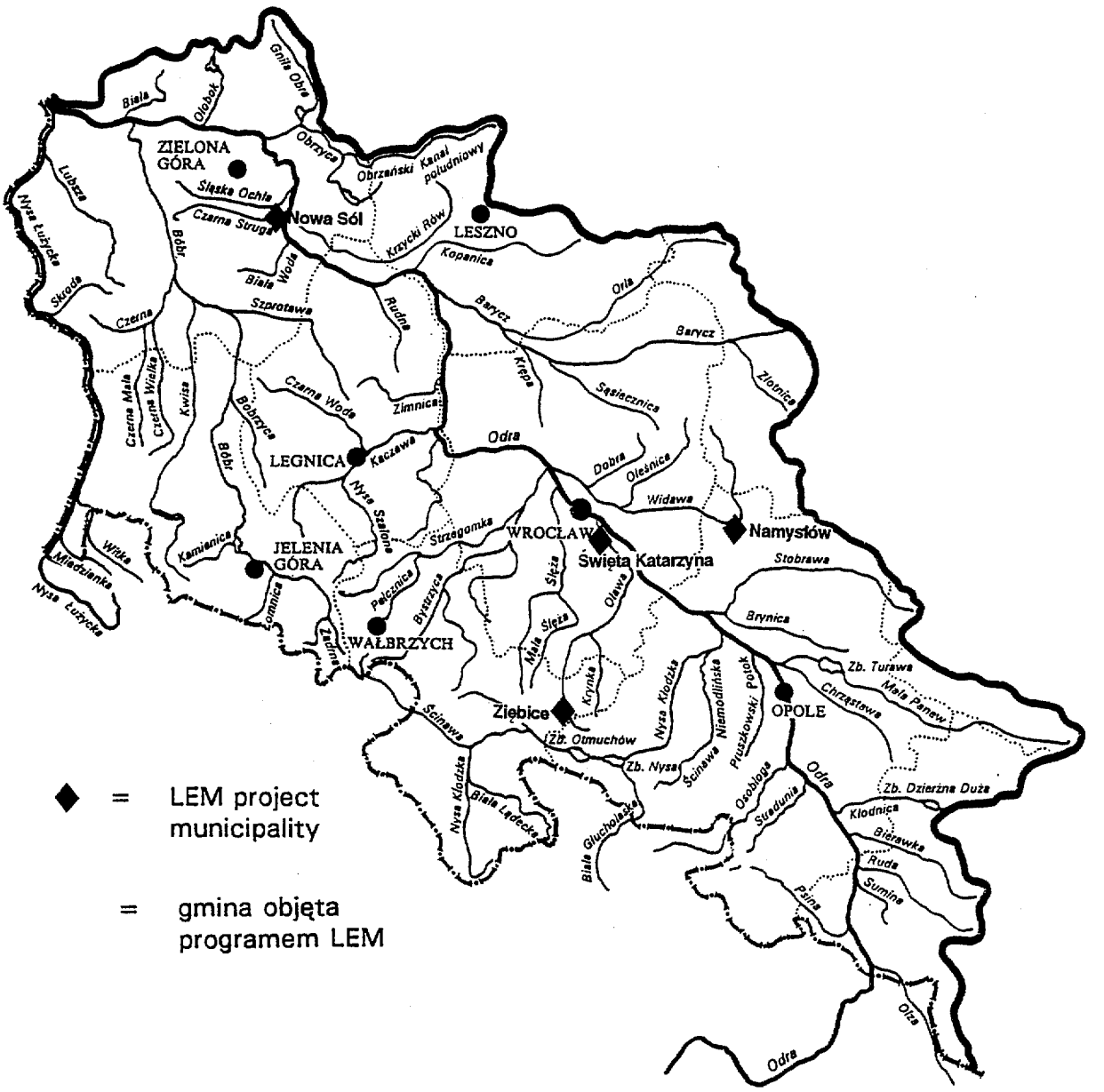


Figure 1.2. Map of the Gmina of Namysłów



◆ = LEM project municipality

= gmina objęta programem LEM

Figure 1.3 Map of the Regional Water Management Authority (Wrocław)

Rysunek 1.3 Mapa obszaru podległego Regionalnemu Zarządowi Gospodarki Wodnej we Wrocławiu

1.5 Survey Team Profile

The Namysłów survey team consisted of (1) Dr. Jan Oleszkiewicz, a wastewater specialist and professor of environmental engineering; (2) Mr. Richard Kobayashi, a management and planning consultant; and (3) Mr. Peter Ridder, a consultant in investment banking and development finance. A preliminary investigation of the wastewater situation in Namysłów was conducted jointly in July 1993 by Dr. Oleszkiewicz; Mr. Marek Jasinkiewicz, LEM Assistant Project Manager in Kraków; and Dr. Andrzej Jodłowski, professor of sanitary engineering, Technical University of Łódź. The three survey team members arrived in Poland on October 27 and completed their work in-country on November 22.

Dr. Oleszkiewicz provided technical expertise in evaluating the design of the newly constructed sewage treatment plant for Namysłów, with particular reference to the feasibility of meeting the permit requirements. He physically inspected the plant under construction as well as all elements of the existing infrastructure and facilities, including all points of entry of wastewater into the Krasowicka Struga, Młynowka, and Widawa; and he evaluated the appropriateness of pretreatment for the wastewater discharges from the brewery and other small industries in the area. He inspected the ZPZ potato processing factory, with its industrial processes and its pretreatment plant, as well as distilleries in Przeczów and Minkowskie.

Mr. Kobayashi's principal role was to analyze and assess the overall management capacity of the gmina, and in that context, to evaluate the gmina's capacity to manage and implement plans and projects that would contribute to enhancements in environmental health.

Mr. Ridder performed a financial analysis of the gmina and its environmental programs. He analyzed the gmina's financial status, the finances of the Namysłów Water Company, the financing plan for the new sewage treatment plant, and the financing options for new environmental spending. Mr. Ridder also evaluated the cost of debt, the historical changes in revenues and expenses, and the debt capacity of the gmina and Water Company.

2 TECHNICAL ANALYSIS

The technical analysis for Namysłów focused on a review of existing conditions in environmental health, an examination of environmental problems and priorities related to wastewater treatment, and possible solutions and recommendations. As a result, the chapter structure is closely tied to the three highest priorities: the main sewage treatment plant that was nearly complete in November 1993, wastewater disposal for the ZPZ potato processing factory, and wastewater treatment in the gmina's villages and small industries. The team also examined contributions of the gmina's projects now in progress, or being considered, toward improving health conditions.

2.1 Existing Conditions

The gmina has two sets of wastewater-related health problems needing attention. These are visible and long-established; however, cost-effective solutions still have not been well defined.

The first set concerns the environmental health situation in the town itself. In the town, the major threat to the community is the continuing spreading of wastewater from the potato processing factory (Zakłady Przemyslu Ziemniaczanego, or ZPZ) onto land, using a combination of irrigation/infiltration and surface runoff. The irrigation operation takes place within the hydrogeological drainage area that is a source of water for the town of Namysłów. The wells in that water intake are shallow (9+ m deep) and unprotected by any impermeable aquitard formation. Thus, the unprotected aquifer that provides up to two-thirds of water for the town of Namysłów is directly threatened. An examination of area conditions revealed a potential for secondary contamination through seepage from the surface ditch that drains the wastewater irrigation fields. Ammonia levels in raw water from the wells sometimes exceed the concentrations permitted for drinking purposes.[2] The Namysłów Water Company (Wodociągi Namysłowskie) reports occasional bacteriological contamination of the well water, which could also be caused by manure fertilizer applied to garden plots in the immediate vicinity of the intake. Figure 2.1 illustrates the situation and demonstrates the threat to the water supply system of the town. The ZPZ company has a temporary permit for this type of wastewater management and the operation is within the prescribed guidelines for distance from water intakes. However, the potential for contamination is great and corrective action is urgently needed.

[2]Rozporządzenie Ministra Zdrowia z dnia 4.V.1990 w sprawie norm wody do picia i na potrzeby gospodarcze [Act of the Minister of Health on water quality standards], Dz. U. 35, poz. 205, 1990.

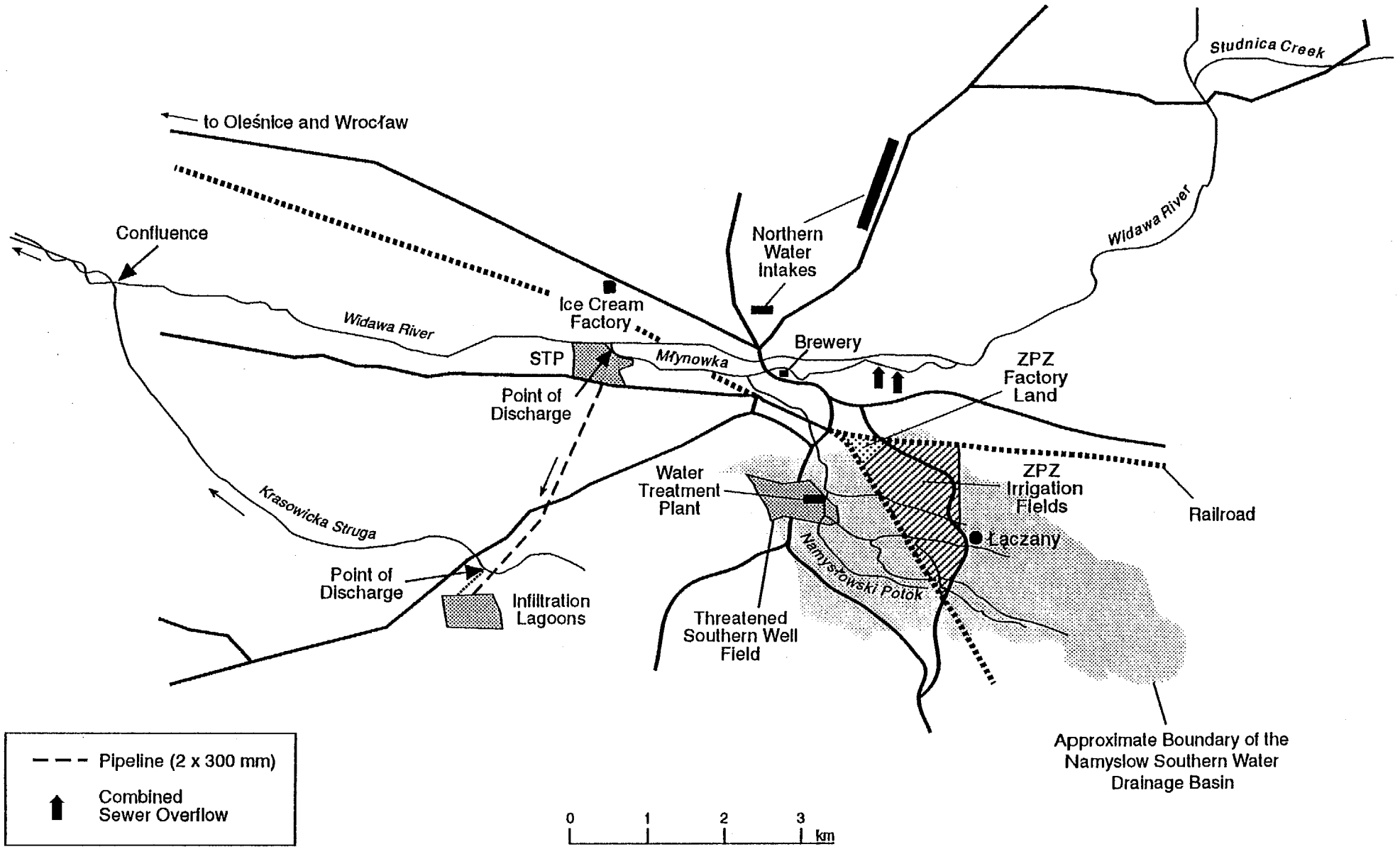


Figure 2.1 Map of the city of Namysłów, with industry and water/sewer facilities

The second set of problems involves the 32 villages and the small industries dispersed throughout the rural part of the gmina. Similar threats of groundwater contamination and actual incidents of contamination have been reported in this area. A recent study funded by the German-Marshall Plan's Wrocław office[3] for the southwestern part of the gmina—the villages of Mikowice, Ligota Książęca, Barzyna and Brzozowiec—has demonstrated that most of the shallow groundwater is contaminated with chlorides and nitrates that have a negative effect on aquatic organisms. The contamination is a result of the poor sanitary condition of rural homesteads. Illegal connections and leaking holding tanks, as well as poorly located wells, contribute to the environmental health threat in the rural areas. Uncontrolled discharges from the distilleries, runoff from fields fertilized with animal wastes and distillery slops (residue after distillation), and other fertilizer runoff further contribute to deterioration of the surface and groundwater resources in the rural part of the gmina.

The town of Namysłów poses a major threat to the Widawa river waters through its two combined sewer overflows (although in the last 2 year there was no overflow) (CSOs; Figure 2.1), its storm water outfalls, and the discharge of strong primary effluent through the old treatment plant. (A schematic diagram of the existing plant appears as Figure 2.2.) The infiltration lagoons (covering almost 20 ha) discharge to a ditch that joins with Krasowicka Struga. Krasowicka Struga (see photograph, Appendix A) is essentially anaerobic and emits strong septic odors. It crosses the highway from Namysłów to Przeczów, then empties into the Widawa River, which was recently designated to reach the first category of water quality (i.e., fit as a municipal water supply) in the future.[4] Some studies have been completed on the potential for developing the Widawa as an alternative source of water for the city of Wrocław. At the moment, the river cannot be classified because of its poor bacteriological quality.[5] Given the Widawa's present and intended municipal and recreational uses, there is an urgent need for cleanup of all major contributors to the pollution of this river.

Given the large scope of these urban and rural wastewater treatment problems, LEM has established the following priorities, focusing on the main problems and exploring how the project can participate in resolving them.

---

[3]J. Krysza et al., Określenie możliwości samooczyszczenia wod gruntowych w rejonie wsi Barzyna, gmina Namysłów [Determination of the self-purification capacity of the groundwater in the vicinity of the village of Barzyna, gmina Namysłów], Final Report for the German-Marshall Plan, Wrocław, 1993.

[4]The three categories of water purity in Poland are: water for drinking and for industrial plants requiring equivalent purity (category I); water for livestock, public bathing, and recreation (category II); and water for remaining industrial uses (category III).

[5]RZGW [RWMA], Gospodarka zasobami wodnymi dorzecza górnej i środkowej Odry [Water management in the upstream and middle run of the Odra River drainage basin], Wrocław, 1993, 193 pp.

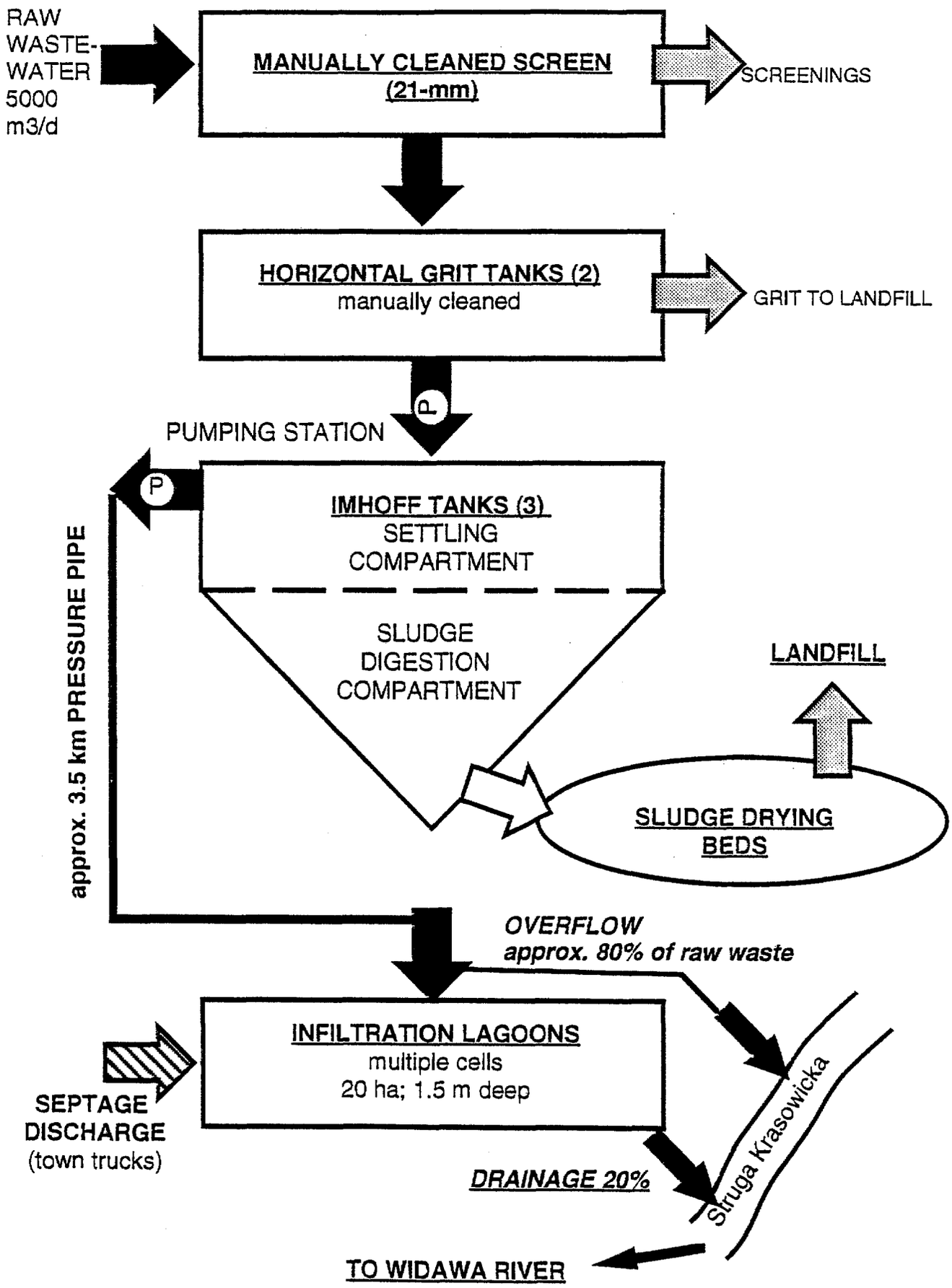


Figure 2.2 **Namysłów sewage treatment plant before upgrading**

Priority 1: Despite the fact that construction costs of the new STP have been a major drain on the gmina's financial resources, the new municipal STP is the first priority, for two reasons. First, among the three main sources of pollution from the town—CSOs, storm water outfalls, and the old STP—the single most important source of contamination of the Widawa river is the discharge of partially treated wastewater from the old STP. Second, in the light of new legislation, lack of adequate treatment facilities could be the main stumbling block to the introduction of new industry into the gmina.

Priority 2: Due to the proximity of the ZPZ irrigation fields to the water intake area of Namysłów, the potato factory is definitely high in priority but second to the new STP.

Priority 3: The management of sewage in the rural areas is of prime importance to those villages; however, if the money for this effort is to come from the same source as for the other two tasks, it would appear to rank third in priority of execution.

2.2 Main Sewage Treatment Plant, Namysłów

2.2.1 Background

Namysłów's new main treatment plant was designed to treat the combined wastewater from households, commercial users, and small industries. Wastewater from the two main industrial users—the brewery and the new ice cream plant—was to be handled and/or pretreated in separate facilities (when the STP construction began, there were no plans to build the ice cream plans). Moreover, Namysłów planned to combine pretreated ZPZ wastewater in the STP for joint treatment during the production season.

But because of ZPZ's precarious financial condition (discussed in Section 2.3.1) and consequent inability to share in the financing, the town asked the Hydrosan design firm to exclude ZPZ and design a treatment plant restricted to wastewater generated in the town of Namysłów. The brewery wastewater would be treated as planned, either by separate treatment and individual discharge to the Widawa river, or by pretreatment for load reduction to 300 mg/L biochemical oxygen demand (BOD_5) and combined treatment at the municipal STP. At the time the design data were completed, there was no information on the organic and nutrient load contributed by the new ice cream manufacturing plant. LEM estimated the load based on comparative data (see Appendix B).

The idea of treating the brewery and municipal wastewater separately has been debated for several years. Two solutions were proposed:

- pretreatment plant built at the site of the brewery and discharge of the pretreated wastewater to the municipal sewer, at an estimated cost of at least zł 15 billion; or
- construction of a pretreatment plant on the site of the Namysłów STP and pumping of the raw wastewater from the brewery to the STP site, at an estimated cost of 5.4 billion zł (pipe and pumping costs, zł 1.5 billion, are included).

The city chose the second option, namely, to construct a full pretreatment plant at the site of the STP. The plant was to consist of screens and a trickling filter clarifier/retention basin combination. The additional cost of the pretreatment plant and the pumping station with the pressure line was to be incorporated into the total, which then would be split between the town and the brewery, with the latter contributing 46% of the cost. The total cost of the whole enterprise was estimated at zł 60 billion.

When the LEM team arrived in October 1993, construction to upgrade the existing plant was 75% complete. (In reality, the extensive upgrading amounts to building of a new sewage treatment plant.) The nearly finished plant consisted of three parallel trains, with one nominally "assigned" for the brewery wastewater. The flow diagram for the plant in the process of being constructed is presented in Figure 2.3. Construction of the brewery's pretreatment plant had not yet begun.

The LEM team inspected the treatment plant under construction and analyzed the full set of design documentation prepared by Hydrosan. The team offered several constructive critical comments, which were discussed with the design engineers. The comments were directed at improving the plant's performance with minimum investment costs. The direct critique of design items is presented in Appendix C; many of the criticisms presented below and in Appendix C originate with the lack of a feasibility study comparing optional treatment solutions.

2.2.2 LEM Recommendations for the STP

Section 3.4.1 contains two management recommendations that are closely tied to the technical recommendations listed here: to ensure that plant personnel are thoroughly trained in their duties, and to hire a local outside expert to be available on an as-needed basis for diagnosis and advisement. The outside expert should be knowledgeable about biological nutrient removal, either from having studied it in small scale (pilot scale) or from directly supervising the startup and operation of plants of this type.

The main technical recommendations are presented in Figure 2.4 and itemized, for ease of referencing, below.

1. Influent quality and quantity were recalculated as presented in Appendix B. The assumed flows for LEM's recalculation were $Q_{average}$ = 5100 m^3/day; $Q_{max,h}$ = 385 m^3/h. The calculated concentrations were then BOD_5 = 577 mg/L; COD = 1009 mg/L; N = 59 mg/L (ammonia 38 mg/L as N); P = 13.3 mg/L (phosphates 8.1 mg/L as P). The lowest temperature was assumed to be 10 °C. These calculations include the brewery and ice cream plant wastewater <u>without separate pretreatment.</u>

2. Calculations lead to the conclusion that the brewery wastewater treatment should be combined with the main treatment train, together with the city effluent. If there ever is a push toward separate treatment, and a pipeline is built to the STP, then the Imhoff tanks should be used for regulating the flow and quality of the wastewater and for anaerobic pretreatment. At the moment, separate pretreatment does not seem necessary.

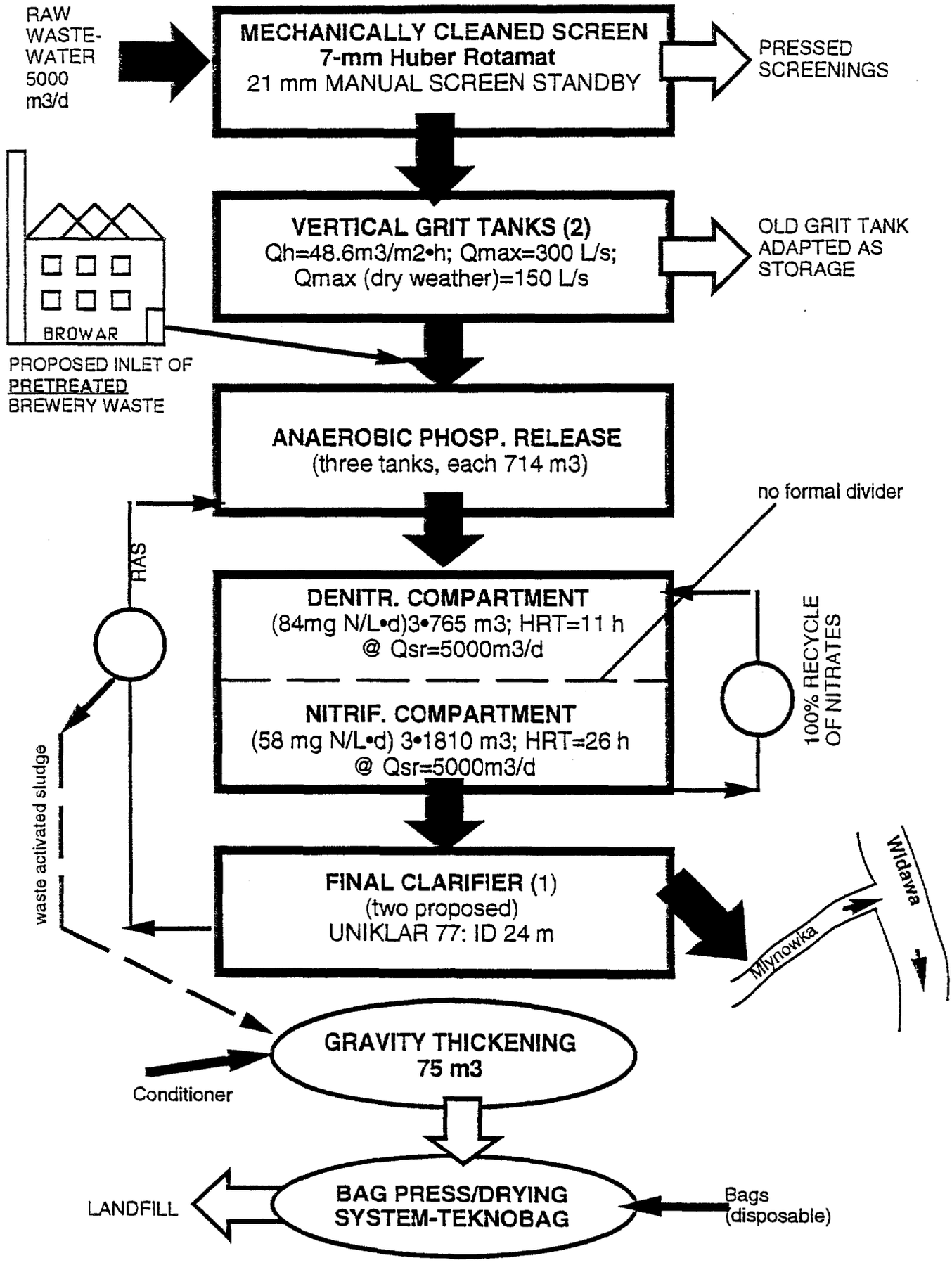


Figure 2.3 Schematic of the new sewage treatment plant proposed by Hydrosan

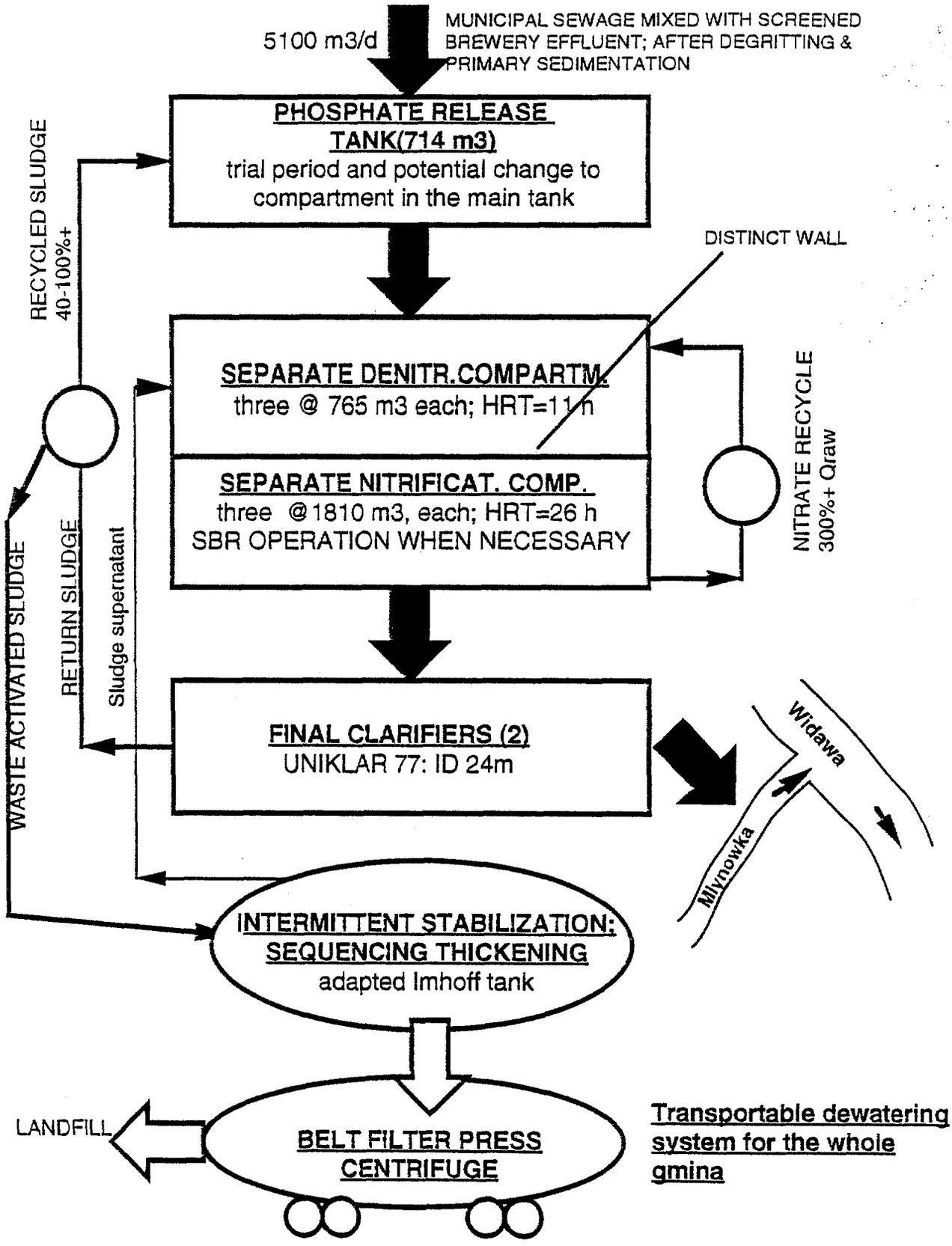


Figure 2.4 LEM proposal: Elimination of the brewery treatment plant and solution of the sludge processing train, Namysłów STP

3. The biological process parameters were recalculated by lem on the basis of the available data and U.S. literature,[6] and on the German ATV methods widely used in Poland, assuming conservative growth rates and yields. They are presented in Appendix B. The results confirm that the overall size of the three parallel treatment trains is adequate for treatment of all of the wastewater streams without pretreatment.

4. The grit removal from the grit chamber should be mechanized and should include a conveyor and grit washer. This solution would cause no odors.

5. The converted Imhoff tank may be too large to serve as an anaerobic phosphorus release reactor. A hydraulic residence time of 765 m^3 / 5100 $m^3/d \bullet 24$ h = 3.6 hours is approximately twice as long as the usually recommended retention time. Actual practice would show whether the size of the tank was causing a problem with undesirable odors, higher volatile organic acids (only acetic acid is necessary for phosphorus release), and inhibition of phosphate release. Should the reactor in fact be too large, provisions should be made to recycle the sludge to the front end of the anoxic-aeration tank (see Figure 2.4). This recycling would mean carving a small anaerobic compartment out of the anoxic tank section, as shown schematically by a dashed line in Figure 2.5. This recommendation is tentative and might have to be revisited if there were problems during the startup.

6. A mixed-liquor recycle pump should be designed to handle up to 300 to 400% of the raw wastewater flow, Q_{raw}, to control the extent of the denitrification reaction.

7. Access to piping must be provided for flexibility in modifying the process (e.g., to the University of Cape Town [UCT] process; indicated by the dashed line in Figure 2.5). This is not a recommendation for additional construction now. Rather, the LEM team recommends planning how, at a later date, modifications could be made with minimum disruption.

8. Having only one clarifier may be a problem whenever the clarifier needs service. For these periods, the reactors could be operated as sequencing batch reactors with continuous inflow. Submersible pumps should be installed or be ready for installation in case the only clarifier fails.

9. If longitudinal short-circuiting affects the delineation between the two regimes (anoxic and anaerobic), fiberglass or polyethylene baffles should be provided as shown in Figure 2.5). Evidence of this effect would be a decrease in the efficiency of the process and lack of a clear redox potential boundary.

[6]Metcalf and Eddy, *Wastewater Engineering* (New York, McGraw-Hill, 3rd ed., 1991); C. Randall, J. Barnard, and D. Stensel, *Design and Retrofit of Wastewater Treatment Plants for biological Nutrient Removal* (Lancaster: Technomic Publ., 1992).

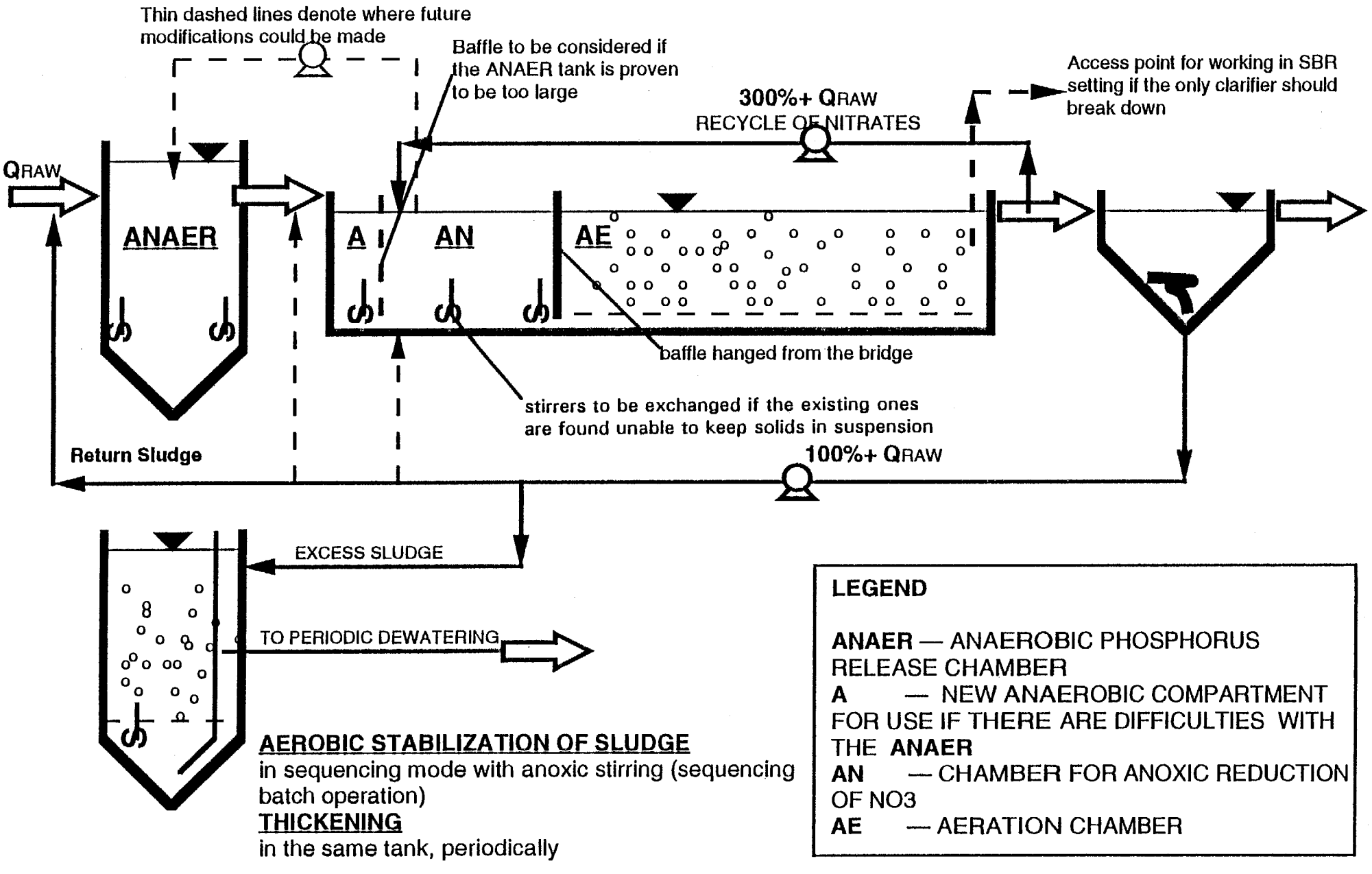


Figure 2.5 Schematic of the LEM proposal for improvements to the new STP

10. The designer should change the stirrers in the anoxic and anaerobic compartments, at no cost to the gmina, if the stirrers chosen are not able to keep the solids in suspension.

11. LEM proposes a sludge treatment train (see Figure 2.5). The size of the tanks modified from the existing Imhoff tank is ideal to accommodate the sludge generated in the process. Depending on the quantity of sludge and the mode of operation, one or two tanks could be used. Initially, one tank would appear to be sufficient. It could be operated as a sequencing batch reactor and have an anoxic stirring period (stirrers are already there) that would help restore some of the alkalinity lost in the process. Batch mode would allow decanting of the supernatant, as well as the centrate or filtrate from dewatering, back to the anoxic section of the tank.

12. The dewatering of solids would have to be performed on site using a stationary or transportable dewatering device. Two types of devices should be compared: the solid-bowl decanter centrifuge and the belt filter press. The advantages of both are their compactness and high throughput. The centrifuge is more energy-intensive but also offers less contact of the operator with the material. The belt filter press requires fairly skilled operation and is less suitable for highly odorous and obnoxious solids. There soon will be a precedent for using the portable dewatering device, in another gmina—i.e., Ziębice, in Wałbrzych voivodship. LEM favors the transportable solution since there are other areas in the gmina where the device could be used as well: ZPZ, Głuszyna, and a series of new rural sewage treatment plants. If the gmina were to purchase this equipment, it could also market the service in neighboring gminas to generate additional revenue.

13. The chemical program for sludge handling should be subjected to treatability studies and regular bidding among several companies, to minimize the cost to the gmina.

14. A small laboratory should be built so that the plant operator can do basic analyses to assess the plant's performance. The lab should be equipped with a portable COD analyzer, a small spectrophotometer for COD analysis, an inexpensive microscope, an oven/dryer for solids analysis, an incubator for BOD analysis, some basic equipment for cleaning glassware, storage cabinets for a few chemicals, etc. A separate room with a sink should be set aside for small projects such as testing sludge quality and chemical dose, calibrating dissolved oxygen (DO) and redox potential probes, etc.

15. In cooperation with the expert selected to help oversee the plant on a long-term basis, the gmina could benefit from developing a computerized "expert system" that would automatically help locate the problem and solutions. A set of rules and typical problems could be collected from daily operations and fed into the database. LEM could help develop such a system, along with an interactive training model using electronic simulation to show operators the effects of various actions.

2.3 Problems and Recommendations for the ZPZ Potato Processing Factory

2.3.1 Background

The potato processing factory, ZPZ, is a fluctuating or seasonal industry (i.e., it operates when potatoes and other vegetables are available) that consists of three more-or-less separate industrial processes: starch processing, a distillery, and a potato-drying division.

The starch plant processes 300 t/d of potatoes; using 7.8 m^3/d of water per ton of potatoes, it generates some 44 t/d of starch. Its production cycle lasts 156 days. The manufacturing process and equipment are old and water-intensive. The starch plant is in the process of being modernized and plans are to employ newer technology, processing 350 t/d potatoes and using only 4 m^3 of water per ton of potatoes. The starch plant at the moment produces some 2340 m^3/d of wastewater.

The distillery is one of busiest and most profitable divisions at ZPZ due to increasing demand for alcohol. It produces 3000 L/d of 97% alcohol, which is sold to the state monopoly distillery in Wrocław. The plant operates for 266 days and uses damaged or rejected potatoes, producing 75 m^3/d of wastewater (12 L of wastewater per liter of spirit) and 20 m^3/d of distillery slops. The slops are either given away to farmers for animal feed or dumped separately on land owned by ZPZ.

The third division produces dried potato cubes used by restaurants for making soup (see photograph, Appendix A); however, at times this division may dry other vegetables, such as carrots. The potato-drying division operates 276 days per year and processes some 70 t/d of potatoes, producing 8-9 t/d of the dried product and generating some 500 m^3/d of wastewater.

The total production of wastewater by the plant is approximately 2915 m^3/d. After the starch operation has been upgraded, there will be 1975 m^3/d wastewater. The concentration will increase from 2540 to 3750 mg/L BOD_5, although the total load will remain at 7414 kg/d.

Financially, although the distillery operation is doing well, the rest of the plant is facing declining demand for its products and a need for serious upgrading of capital equipment in the near term. Because of its significant operating losses, there was even some question at the time of the team's visit as to whether this communal enterprise, which is in receivership, would remain open. People from outside the industry see little reason for the dilapidated and run-down plant to continue its existence as a communal or even a privatized enterprise. On the other hand, the gmina's management sees ZPZ as an essential element of its economy. The interim commissioner assigned to manage the ZPZ plant has begun turning things around already, and has improved market access somewhat. LEM has assumed that ZPZ is here to stay, even though at present there are very limited, if any, funds available for major investments in the plant's environmental engineering infrastructure.

2.3.2 Current Wastewater Management

The ZPZ method of wastewater handling is conventional for this industry in Poland—i.e., settling, retention, and land application. The whole wastewater processing train is illustrated in Figure 2.6. The flume/wash water is pumped through screens to the 3960 m^3 grit-removal clarifier. The water is recycled after the solids are removed. The wastewater from the process (so-called "technological water") goes through a foam separator[7] to a wet well. From the wet well, it is pumped to two separate clarifiers (with capacity of 2357 m^3 each) providing a little over 1 day hydraulic retention. From the clarifiers the wastewater enters the 1725 m^3 retention tank common to both the flume excess water and the process wastewater. The retention tank serves as the wet well for the pumps that transfer the wastewater to the irrigation fields. Based on the LEM team's observations, the wastewater sent to the irrigation fields contains the following (all in mg/L):

BOD_5	1760
COD	3772
N	127
P	108
K	265

ZPZ owns 131 ha of land of which the net appropriation to waste disposal amounts to 83 ha of agriculturally active land. Using a crude form of a surface runoff technique, about 25 ha of land is flooded and not used for agricultural purposes. The load-to-land-area ratio appears much too large. Kielczewski et al.[8] report the need to maintain 500 m^3/ha for rapeseed and 850 m^3/ha for grass, while the local Institute for Agricultural Land Irrigation (Instytut Melioracji Użytków Zielonych, or IMUZ) advocates loads as high as 2000 m^3/ha. In any case, the irrigation dose practiced by ZPZ is well above any acceptable dose and, as noted previously, the irrigation land is in an area not suitable for land disposal at all. Almost all of the land owned by ZPZ is within the boundary of the aquifer that slopes toward the shallow wells of the main water intake for Namysłów (Figure 2.1). Additionally, drainage ditches carrying runoff from the irrigation fields flow very close to the shallow wells. According to the deputy director of the Namysłów Water Company, the quality of raw water deteriorates while ZPZ is operating, particularly at well 8 and other wells closer to the ditch discharging to the Namysłowski Potok.

PRO-URBI Wrocław is currently developing a comprehensive plan for management of the gmina's resources and land, and has designated the ZPZ irrigation fields for relocation to an area away from the aquifer.

[7]Foam is the main aesthetic problem at the pretreatment facility and in the process of spray irrigation; see photographs in Appendix A.

[8]S. Kielczewski et al., Operat wodno-prawny na rolnicze zagospodarowanie ścieków z ZPZ Namysłów [Regulations for land disposal of ZPZ waste on agricultural fields], Namysłów, October 1991.

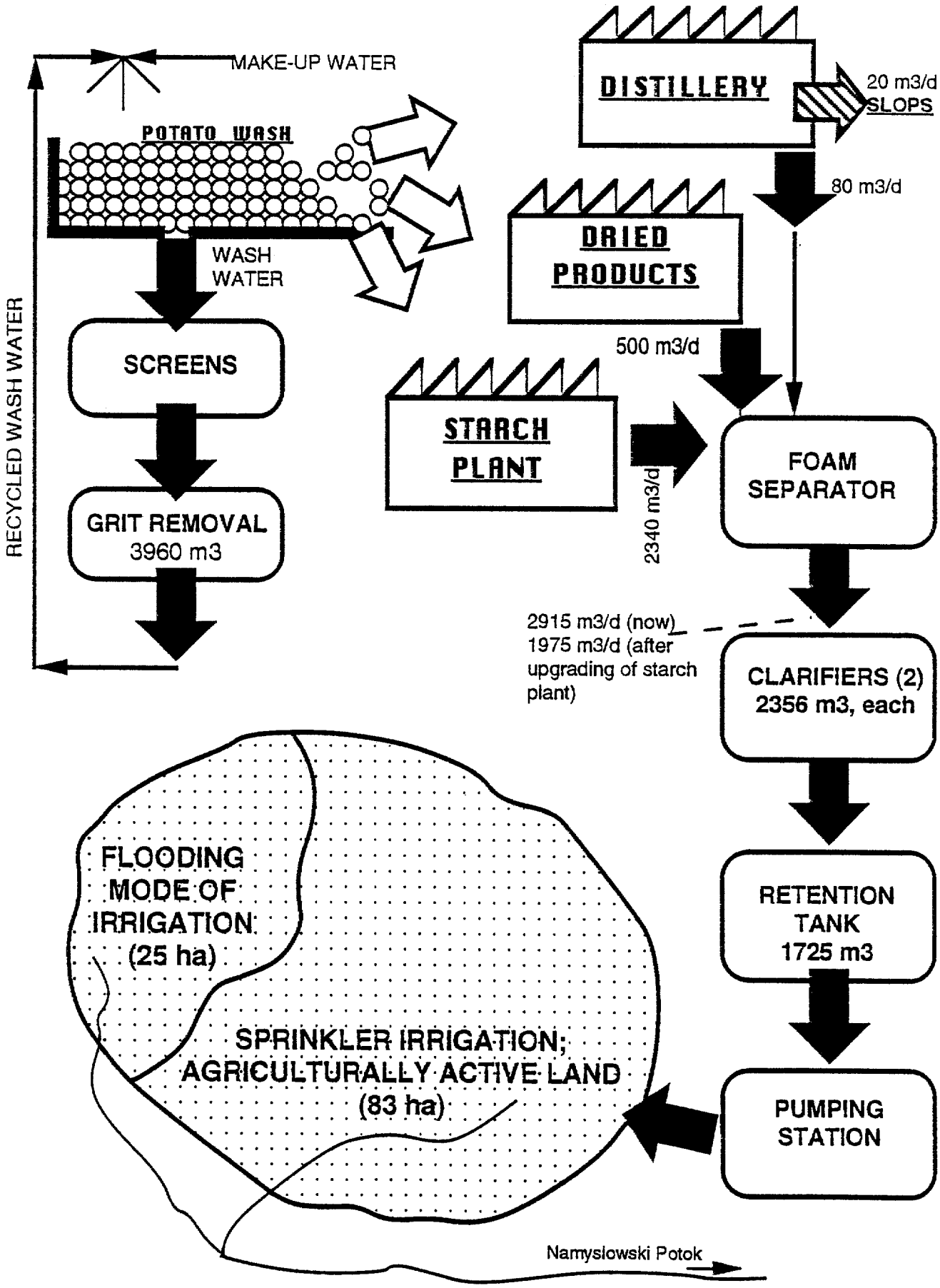


Figure 2.6 Present waste treatment at the ZPZ potato processing plant

2.3.3 LEM Recommendations for ZPZ

LEM's recommendations aim at resolving the issue of endangered water supply for the city of Namysłów as well as suggesting a long-term solution to the ZPZ wastewater problem. The LEM team believes that intensive (high dose per hectare) land disposal in the hydrogeological drainage area of the major water intake for Namysłów is not acceptable even though the nominal regulated protection zone (300 m) is being maintained. Immediate action is necessary and the extent of investment basically hinges on the financial future of the ZPZ factory.

LEM sees three approaches to the problem:

1. Dispose of wastewater, pretreated at the existing pretreatment facility, to the newly constructed STP for Namysłów;
2. Relocate the irrigation fields away from the drainage basin of the water intake strata; or
3. Treat the ZPZ wastewater separately, on-site or off-site, and discharge to surface waters.

These options are discussed below.

Disposal to the STP

This solution would require transportation of the wastewater by pipe to the STP site. The estimated cost of a 3.5-km separate pressure line and pumping station is between zł 4 and 5 billion (Appendix D, Table D-1). The cost is higher than usual for rural areas because of the need to lay the pipeline through the town proper. Added to this amount would be the cost of pretreatment beyond that presently available at ZPZ (Figure 2.6). This variant would be feasible only after the projected water-conserving upgrading of the starch plant was implemented.

The new construction proposed by LEM would involve development of anaerobic methanogenic pretreatment in the existing Imhoff tanks; these tanks form an ideal structure for implementation of (1) an upflow anaerobic sludge bed (UASB) reactor or (2) an anaerobic hybrid reactor containing plastic media at the top 25-30% of the volume to separate sludge from liquid effluent and gas. Following the anaerobic methanogenic pretreatment, the ZPZ wastewater would join de-gritted domestic sewage and enter the anaerobic phosphate release compartment carved out of the main tank. The proposed solution is presented in Figure 2.7. Conversion/upgrading of clarigesters (i.e., reactors like Imhoff tanks) in this manner is a well-tested method that has been applied for the past 20 years in other parts of the world.

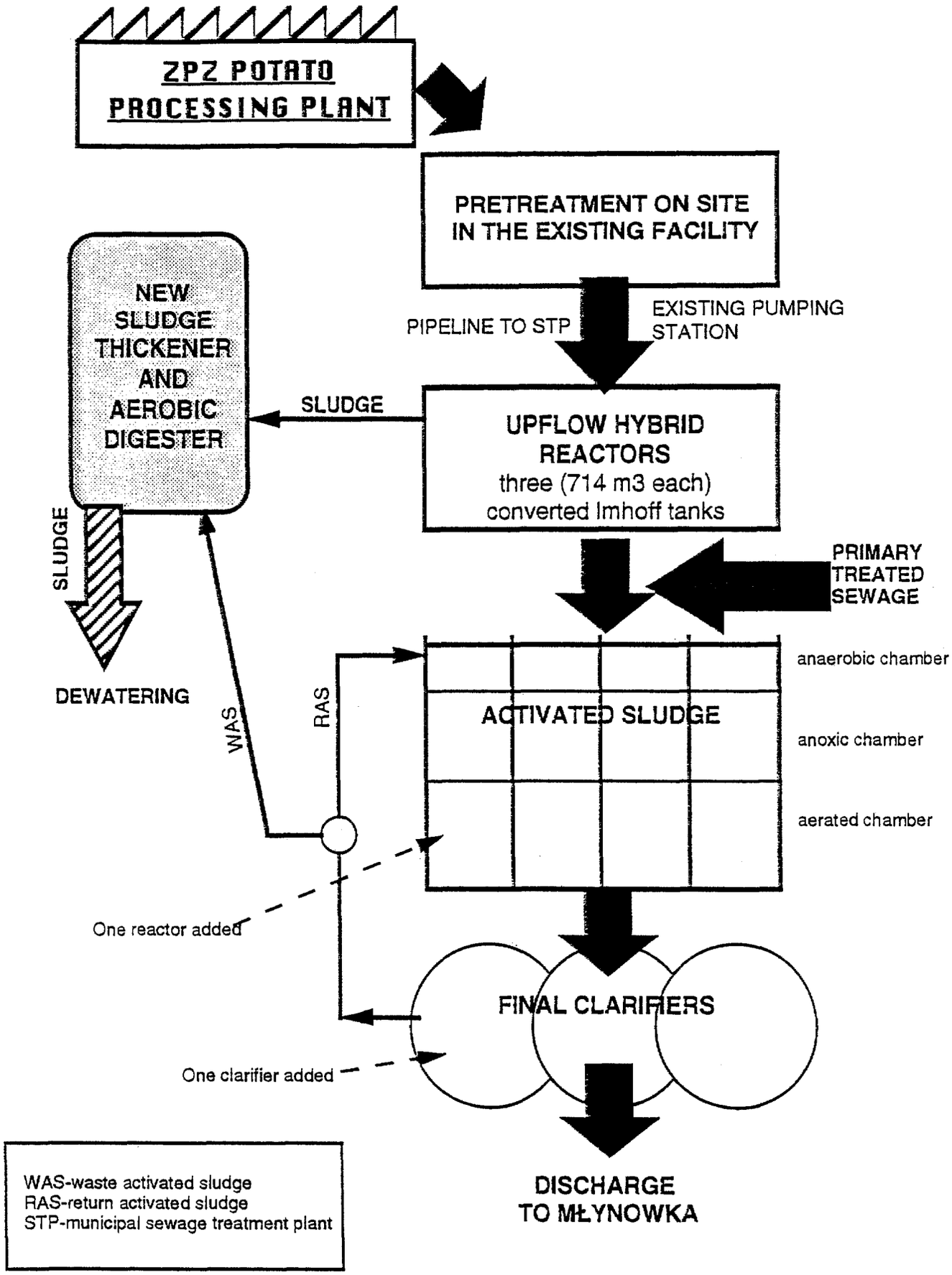


Figure 2.7 ZPZ wastewater treatment Option 1 — Combined treatment at the municipal STP ("unlimited funds" solution)

Because the incoming ZPZ wastewater already would be pretreated in properly functioning[9] settling tanks located at the ZPZ site, where some 35% of the BOD, chemical oxygen demand (COD), and nutrient loads would be removed, the ZPZ wastewater load entering the STP would be 4820 kg/d BOD and 1975 m^3/d.

Assuming that three existing Imhoff tanks were employed, the volume available would be 2142 m^3. This volume would provide an HRT of over 24 hours, and a BOD load of 2.3 kg/m^3 × d, resulting in the removal of at least 75% of BOD load—assuming that enough biomass accumulates in the reactors.[10]

The residual load after pretreatment would be 1205 kg/d. One can assume that this additional treatment train—making four altogether—would guarantee attainment of discharge limits required by the current permit. The main reactors have been left with a concrete lip and protruding reinforcing bars (rebars) to allow for structural attachment of another train (see photograph, Appendix A). Seasonal production would not be a problem because the anaerobic methanogenic pretreatment process would not be disrupted by lack of feed and could be put into full operation immediately as production increased.

The cost for this option would be zł 29 billion, including an additional reactor, clarifier, and aerobic digester (see Appendix D, Table D-1). This very high cost has earned this option the name "unlimited funds" solution.

A variant proposal with less construction but still capable of delivering final effluent of secondary quality (BOD = 30 mg/L; P = 5 mg/L; total N = 25 to 35 mg/L) would cost approximately zł 16 billion and would include:

- three Imhoff tanks converted to anaerobic methanogenic pretreatment,
- new sludge stabilization reactor,
- same number of clarifiers (i.e., assuming that the second clarifier will be built for the existing plant as soon as the money is available, regardless of what happens with the ZPZ wastewater), and
- no new aeration capacity.

The total retention time in the activated sludge section would decrease and nutrient removal would be only partial. This process might be used as a staging step to facilitate financing if the current discharge permit were to allow this option.

---

[9]"Properly functioning" means corrected well beyond the performance of the existing ZPZ wastewater pretreatment plant.

[10]The resulting load is light for a high-rate anaerobic system, so the plant could take on an additional load for pretreatment (e.g., brewery wastewater). The Schöller ice cream plant would not be included in this pretreatment scheme, although its maximum load, at 200 m^3/d and potential BOD of 3000 mg/L, is quite high. If the ice cream plant were to be included, a separate pressure line from Schöller to the STP site would have to be constructed. The present capacity of the municipal STP makes this seem unnecessary.

In connection with the zł 16 billion solution, it should be added that Namysłów would no longer be a municipal STP after receiving the ZPZ effluent. The combined municipal domestic sewage load (see 1995 calculations in Appendix B) would be 1020 kg/d BOD_5. Industry would contribute as follows (all in kg/d BOD_5):

small industry plus ice cream plant	805
brewery	715
ZPZ after pretreatment	4820
TOTAL	6340

The total load treated would then be 7360 kg/d, of which the industrial load (during the season of ZPZ operation) would be 86.2%. Thus, the plant clearly would qualify as an industrial rather than municipal treatment facility. As such, it could qualify under the exemption from meeting effluent nitrogen and phosphorus levels allowed under item 4, Rozporządzenie Ministra Ochrony Środowiska, 1991,[11] which says that industrial plants may become exempt if a "social interest" issue is involved.[12] It must be noted that this suggestion by LEM has not been calculated to the same level of detail as the one presented in Appendix D. Once the fate of ZPZ is established, this calculation should be done.

Land Disposal

The present method of land disposal in the immediate area of the hydrogeological drainage basin that feeds the main groundwater intake is not acceptable. The land area available is inadequate, only 108 ha net area; excessive loads thus lead to stagnation of wastewater on the surface, followed by surface runoff to ditches and streams. A minimum of 180 ha is needed to correct the situation.[13] Further, under the required 5-year land use plan, the gmina must have a larger protection zone around agricultural land disposal areas, which would mean that even less of the 108 ha currently in use would be available for disposal by ZPZ. Finally, the work by Kielczewski et al. did not take into account the actual location of the disposal site—on top of the Namysłów potable water aquifer. That is, the disposal site should not be there at all, regardless of any required protection zones.

---

[11]Rozporządzenie Ministra Ochrony Środowiska z 5.XI.1991 w sprawie klasyfikacji wód i warunków jakim powinny odpowiadać ścieki odprowadzane do wód lub ziemi [Act of the Minister of Environmental Protection about water classification and conditions for discharge of wastewater to water and soil], Dz.U. 116, poz. 503, 16.XII.1991.

[12]"Social interest" in this instance would mean that the ZPZ plant would be saved to provide employment, that the municipality would be served as well, and that even with the exemptions, primary effluent quality would improve beyond its present condition and secondary effluent requirements would be met, which would be of immediate benefit to human health.

[13]Kielczewski et al., 1991.

LEM proposes to develop criteria to relocate the land disposal area—for example, beyond the village of Łączany (Figure 2.1). A considerable cost would be associated with this proposal due to the need to lease or purchase land, install new irrigation equipment, dig new ditches, lay piping to the site, and account for the added pumping costs. These costs, however, could be lower than those of other options. Furthermore, if this solution were presented as a form of sustainable development (i.e., nutrients are recycled rather than disposed as a nuisance), it could be seen as superior to options in which treated waste is discharged to surface waters. An intermediate solution would be to continue discharging in the area as practiced now, but to increase the total area available, and considerably lower the dose per hectare. The costs used for comparison in Section 2.3.4 (Appendix D, Table D-2) are for a completely new set of irrigation equipment, assuming that no existing sprinklers and distribution pipes would be salvageable.

Using the IMUZ rough cost estimates of zł 400 million per hectare, complete with sprinklers, roads, etc., but without the cost of land, the cost for a new irrigation area for ZPZ at this unit cost would be (zł 400 million/ha) × (180 ha) = zł 72 billion.

Land costs could add zł 440 million/ha to the already high costs of the irrigation infrastructure—if the gmina has to purchase/lease the land or redesignate its use, at a cost of 200 t/ha of rye grain.[14] This calculation of land value would not be justified, however, if the fields did not displace any crops and instead continued to be used for agricultural purposes. Thus, the flooded-field mode of disposal (such as the method incompletely practiced by ZPZ) should be avoided, since in this mode no crop is produced and the land is used instead as a filtration and sorption unit.

This comparison of very high costs, regardless of which calculation is used (zł 50 or 72 billion), shows that proper irrigation in the completely new area would be economically impossible to implement. Nevertheless, ZPZ already has irrigation equipment and expertise and partial solutions may be possible. LEM recommends a study of the existing land disposal area to estimate the potential for handling a small fraction of the wastewater in the present land parcel. No flooding or wastewater storage should be allowed in the area of the hydrogeological drainage basin. Only light doses should be allowed. Likewise, crops requiring the minimum of chemical addition should be cultivated. The land beyond the village of Łączany should be negotiated for irrigation and the remaining wastewater sent there, using the existing pumping station. It is stressed that this would be a stage in the process of complete elimination of land disposal from the vicinity of the aquifer. This minimum-use option might cost much less, perhaps (180 ha-108 ha)/180 ha) × (zł 50 billion) = zł 20 billion.

The new irrigation area could also be selected near the infiltration lagoons owned by the town. The lagoons, after sealing, etc., could offer up to 150 days retention time for the wastewater, thus allowing a more rational irrigation pattern coordinated with weather conditions. The irrigation takes

[14]Rozporządzenie RM z dnia 28.06.1982 w sprawie przepisów ustawy o ochronie gruntów rolnych i leśnych [Council of Ministers' Act on Protection of Agricultural Land, Official Gazette], Dz.U. 20, poz. 149, 1982.

place in the fall and winter—that is, the wet seasons, when there is little or no demand for moisture. As a result, runoff and its associated problems occur.

Separate Treatment

One possible separate treatment system would consist of either a high- or a low-rate anaerobic pretreatment train (USAB with media in the top part of the reactor):

> High-rate method—an up-flow sludge bed (UASB) reactor or an up-flow anaerobic hybrid reactor.
>
> Low-rate method—a series of highly engineered, covered, 10-m deep anaerobic lagoons, unheated, with gas collection and utilization, designed for 10+ days treatment (HRT). The anaerobic lagoons are always followed by aerobic polishing, which consists of a flow-through aerated lagoon, or a sequencing batch activated sludge reactor.

Primary treatment for the ZPZ system would be limited to a grit separator for the flume and wash wastewater. A schematic of the treatment plant proposed in this option by LEM is presented in Figure 2.8; costs are analyzed in Appendix Table D-3. Following the grit separator would be a large anaerobic lagoon, covered, unheated, but with gas collection capability. The gas would be used in the ZPZ process or flared. This lagoon would be designed for an HRT of 12 days (24,000 m^3), and built 8+ m deep. The existing clarifiers for the process wastewater would be converted to the sequencing batch activated sludge process (sequencing batch reactor, or SBR), with excess sludge infrequently removed to the anaerobic portion of the plant. The discharge permit may require removal of nutrients to levels similar to those for the main treatment plant. In that case, the SBR operation would have to enforce nutrient removal, using an anaerobic-anoxic-aerobic sequence. Removing additional phosphorus could require that iron be added to the last aeration basin. To avoid phosphorus release, excess activated sludge would be removed and dewatered by mobile, gmina-owned dewatering equipment without being sent back to the anaerobic section of the plant. If there is no limitation on phosphorus for sludge produced by industrial plants, then the sludge could be sent to the anaerobic lagoon.

An alternate solution would be off-site treatment, where the raw wastewater, after clarification and complete treatment in the existing pretreatment plant, would be pumped to the existing infiltration lagoons, located near Podlesie and Smarchowice Wielkie. The off-site solution would have the dual advantages of (1) using facilities that already exist but are not in service; and (2) removing treatment to a remote location, with the corresponding aesthetic and human health benefits. (Construction costs saved by using existing facilities, however, could be outweighed by the costs of constructing the transportation pipeline.) The existing lagoons would need an impermeable bottom made of clay or bentonite, and would have to be excavated further to a depth of 8 to 10 m. These covered, anaerobic lagoons would be followed by the aerated sequencing batch reactor in the lagoon setting and partial sludge stabilization. The effluent would be polished for nutrient removal in a series of long-residence-time ponds that could conclude with a series of rooted vegetation ponds. The volume

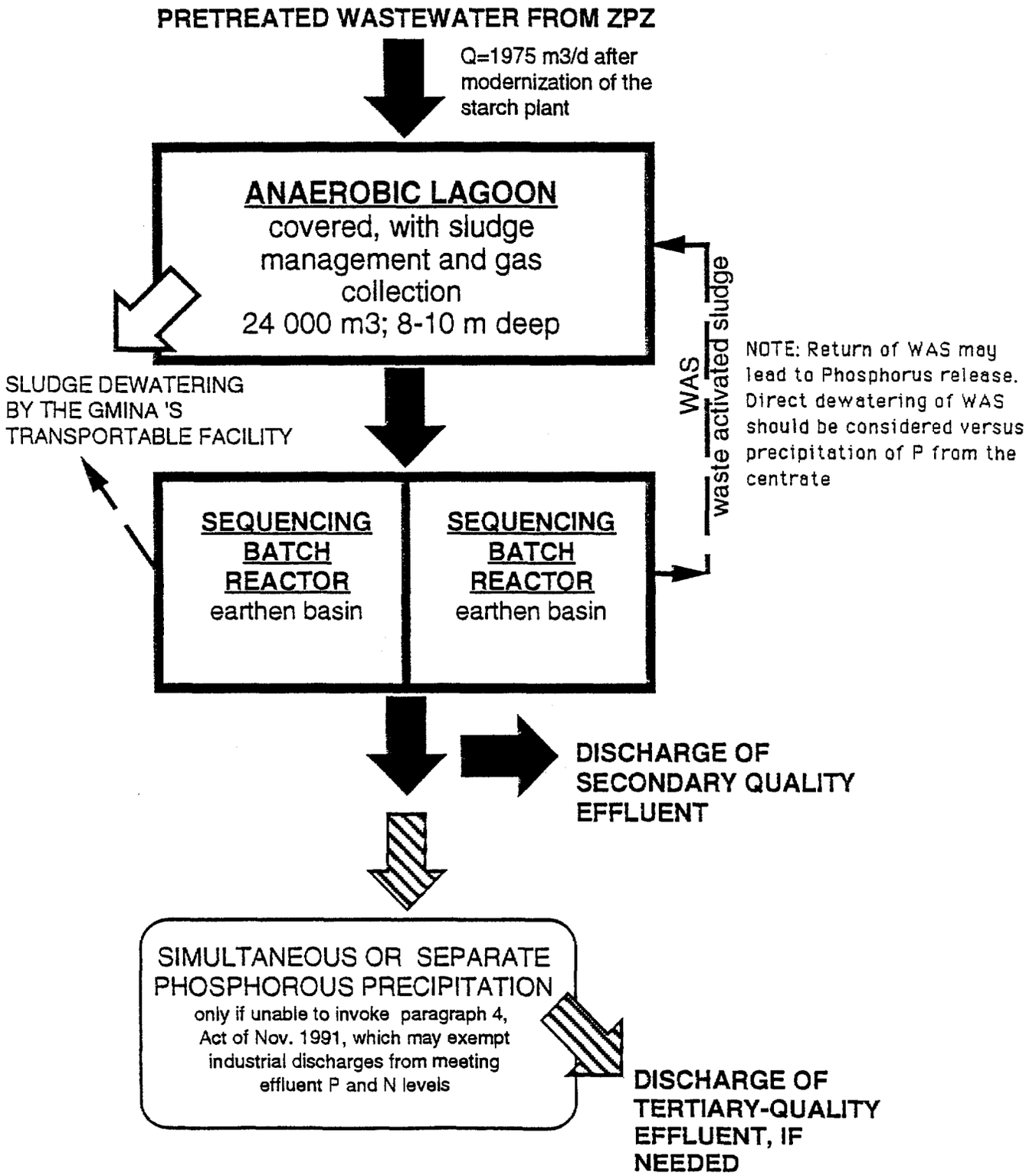


Figure 2.8 LEM proposal: ZPZ wastewater treatment, Option 3 — Separate anaerobic-aerobic reactors

of the existing infiltration lagoons is close to 300,000 m^3, so they could be used to store treated wastewater for agricultural use during periods of dry, warm weather when the moisture and nutrients could be fully used. The overall storage time for the flow of 2000 m^3/d would be approximately 150 days.

2.3.4 Comparison of Options for Disposal of ZPZ Wastewater

The feasible options for ZPZ, along with their estimated costs, are presented in Table 2.1. The costs are based on calculations presented in Appendix Tables D-1 through D-3.

Table 2.1

COMPARISON OF OPTIONS FOR TREATMENT OF ZPZ WASTEWATER
(June 1993 złotys)

	Option 1: Treatment Combined at STP	**Option 2: Land Disposal**	**Option 3: Separate Treatment**
Cost (billion zł)	29	50	30
Advantages	Common location would reduce O&M requirements	Option would be a "sustainable development" solution No problems would occur with surface water discharge	Option could handle seasonal discharge better Option would make ZPZ independent of future municipal participation fee increases
Disadvantages	Seasonal load and daily variability would endanger the BNR process	Odors could be a nuisance Runoff and irrigation drainage problems with nutrients could develop	Separate maintenance could be an added burden

	Option 1: Treatment Combined at STP	Option 2: Land Disposal	Option 3: Separate Treatment
Comments	Treatment is assumed to current permit levels for STP, with tertiary treatment Secondary treatment levels would cost zł 16 billion but would require obtaining an industrial permit	High costs could be cut if existing land were also used; e.g., the initial stage could cost zł 20 billion if only 40% of new land were developed These cost cuts need to be justified by hydrogeological studies	Costs could be reduced if town's infiltration lagoons were used for treatment; 300,000 m^3 volume available; costs for pumping and new pipeline would have to be added

The choice among these options is difficult even though the estimated costs seem to support certain solutions over others. The land disposal option (Option 2) would be viable given some staging—i.e., partial and lighter use of the existing land. If staging cannot be arranged, this option would be very expensive because of the need to gain access to completely new fields (the LEM team does not know for certain whether fields are available) and to purchase brand-new equipment.

Whereas it may appear more advantageous to develop the northern water intake and decrease the water intake from the southern wells threatened by the irrigation fields, such an option is not now available because of the apparently limited capacity of the northern intake. The staging proposed by LEM therefore requires careful assessment of the hydrogeological profiles of the site and delineation of irrigation in the existing area to minimize the potential impact on the aquifer. Pumping beyond the hydrogeological drainage basin of part of the wastewater should be done gradually, continuing the deployment of the existing land. The dose of wastewater per hectare of existing land should be reduced to a minimum, decreasing the threat to the aquifer.

A separate treatment plant (Option 3) would offer ZPZ independence from the town's treatment system, rules, and fees, but would mean that ZPZ also would carry the burden of responsibility for the final effluent quality and the O&M costs. This solution also would be difficult to stage because the voivodship is not likely to approve partial treatment. It is reasonable, however, to expect the voivodship to impose secondary rather than tertiary effluent requirements.

Finally, Option 1—combined treatment with the STP—might be staged if the plant could accommodate the load in the existing aeration tank volume. Although the first stage would cost only zł 16 billion, it might violate the current permit for effluent nutrient concentration while meeting secondary standards. The plant would become an industrial wastewater treatment plant, with only 13.8% domestic sewage (based on BOD load), and it would qualify for an exemption. If treated as

a stage in the push toward attaining tertiary treatment, this solution would be technically and economically acceptable, and would be environmentally ethical.

Once the fate of the ZPZ factory is decided, the options analysis should be redone. Because of the one-time, high-cost expenditure, Option 3 is not feasible. There can be no intermediate stage here to provide a hiatus for debt servicing. Given the difficult financial situation of ZPZ, a staged solution like that offered in Option 2 would be one way to allow the processing of potatoes to continue. If the ZPZ commercial prospects improve, then the combined treatment proposal, Option 1, should be reevaluated as the least-cost solution.

2.4 The Problem of Wastewater Treatment in the Gmina's Villages and Small Industries

The gmina has 32 outlying villages, most of which will have received water service long before their wastewater treatment problems have been solved. The gmina also has several small industrial plants, of which the most environmentally difficult are the distilleries.

2.4.1 Domestic Sewage Treatment in the Villages

At present, the majority of septage from the gmina's villages is collected and transported by truck to the infiltration lagoons associated with the old STP. The lagoons, however, are not an integral part of the new plant design. Further, although the new STP has a septage receiving facility, and capacity could be added (by adapting another large Imhoff tank), the facility is not intended to accept septage loads directly from all the villages. These disjointed elements point to the need for a comprehensive plan for the village systems, as elaborated in Chapter 3. Given an objective of minimizing construction and transport costs, what is the smallest number of plants that can be built for the villages while still obtaining effective treatment results? If septage is hauled or piped to local stations serving several villages, how many villages logically can be connected to the same system, and how should specific villages be clustered? How much will it cost to lay pipeline as opposed to hauling by truck?

A village domestic wastewater management plan, prepared 5 years ago,[15] specified sewerage and treatment plant locations for all villages in the gmina. In 1993 bids were requested for the first treatment plant on the list, at Głuszyna. The bid opening took place November 15, 1993, during the LEM team's visit.

The first decision made was to eliminate Brzezinki village from the sewerage system. Instead, residents will be required to use holding tanks and capacity will be built into the new Głuszyna facility to process Brzezinki's septage. LEM suggested that the owners of the holding tanks not be

[15] Biuro Projektów Wodnych Melioracji (BPWM), Regionalny program systemu kanalizacji dla gminy Namysłów [Irrigation Design Office - Regional program: Sewerage system for the gmina of Namysłów], 25.III.1988.

charged for disposal of septage (calculating the costs into taxes), so as to discourage illegal emptying of the tanks.

The bid opening in November 1993 was for the sewerage and sewage treatment plant combined and was directed at six preselected companies. Only three responded. Their processes, although all aimed at processing 220 m^3/d, were different from one another. The costs of the three proposed sewerage systems were considered to be similar, but the costs for the treatment plant alone varied from zł 2.64 to 4.76 billion. The winning bid featured a sequencing batch reactor and a small polishing pond and had the lowest capital and operating cost, with power use of 0.45 $kWh/(m^3/d)$. The most expensive plant was a lagoon system that featured a long-retention-time aerated lagoon, followed by a lagoon covered with duckweed *(Lemna)*. Interestingly, the third proposal was a miniature version of the one-sludge BNR process. Such a process is not suitable for small flows, due to the complexity of operations required (see recommendation 4 below).

The bid opening offers lessons on how to approach the sewerage problem for the rest of the gmina's villages. LEM's recommendations are itemized below.

1. The gmina or designer <u>should always perform an analysis</u> of the cost of (a) connecting a central treatment plant by pipe/pumping station to a small cluster of homes (or dispersed housing), as opposed to (b) hauling the sewage to a common treatment plant or (c) using septic tanks, holding tanks, and tanks with leaching drainage. The analysis could use rough estimates, e.g., zł 0.9 to 1 million/m of 200- to 250-mm diameter sewer pipe and zł 250 million per pumping station, versus the cost of service by "honey wagons" (septage transport trucks).

2. If holding tanks are selected, as was the case in Brzezinki, which was not connected by pipelines to Głuszyna, then <u>homeowners should not have to pay</u> for hauling waste. Holding tanks should be inspected for leaks, cracks, and illegal connections, to protect the water supply. This monitoring is imperative because unmonitored connections to a local creek can completely negate the efforts of plants in the area that are trying to achieve secondary and tertiary effluent quality.

3. Generally speaking, if there is a choice (Namysłów has only one option, the Widawa), wastewater should be transported to the drainage area of the river or major stream that has a lower target for water quality. Operating costs for plants designed to remove nutrients (tertiary treatment) may be twice as much as those for standard secondary sewage treatment plants.

4. Selection of the treatment plant should take into account ease of operation <u>above all other prerogatives</u>. Village plants are too small to justify hiring expert operators, so must rely on a traveling operator crew; the question of who will supervise this crew should be resolved as part of recommendation #5 below. Costs would be transferred to the homeowner through user fees or taxes. When reviewing design projects for small flows, the gmina should <u>avoid</u> the multiple recycle lines, multiple tanks in series, and clarifiers that LEM has seen in many proposed "package plants," both imported and domestic, now being offered to small users.

5. The gmina must decide who—the NWC, the solid waste authority (ZUK), or some other body—will have operating responsibility for any village systems that require active management, such as the one to be built in Głuszyna. The responsibility need not rest with the same authority in each case, but the gmina may want to make wider use of the technical expertise in STP operation and nutrient removal that will reside at the NWC.

6. The gmina should be aware that the smaller the plant, the more difficult its operation will be and the more strongly its performance will be affected by variable flow and load.

7. Sludge could be managed best with the traveling dewatering device that has been proposed for the Namysłów STP.

8. When evaluating so-called "green" and "ecologically correct" plants, the gmina should make sure, if such designs prove competitive in cost, that they will perform in winter and will not create other operational problems. An example of an additional problem is the management of green biomass (algae, duckweed, rooted plants) when the mass is too small to start an animal feed preparation enterprise. Moreover, there is no assurance that SANEPID, the national public health permitting authority, will approve such feed for animals. Composting, often proposed by the proponents, also has to be managed; it requires aeration and bulking agents and may create leachate. Problems of final compost disposal also arise.

9. Sequencing batch reactors (SBR) have all the necessary features of a high-technology, activated-sludge plant providing nutrient removal. They are ideal for small plants because they offer equalization of flow, well-settling biomass, ease of automated operation, and an operational regime that can be changed as conditions change. They can even be built in earthen basins, and require the least maintenance among the suspended-growth processes.

9. In addition to listing in its bid advertisement all items required, the gmina should verify that the design engineer will be available long after the plant is commissioned, to answer questions, advise on problems, and aid in operation.

2.4.2 Rural Industry in the Gmina

LEM was asked to look at one particular rural industry—the agricultural distilleries. There are four distilleries in the gmina: Minkowskie, Przeczów, Smogorzów, and ZPZ. The team visited three of the four sites—Minkowskie, ZPZ, and Przeczów—and inspected the installations for alcohol production, wastewater, and slops. In general, the gmina considered the distilleries to have a slops disposal problem, although the slops are considered to be a good additive to animal feed. LEM was assured that the slops were being disposed on "compost," or fertilizer-producing, heaps consisting of layers of dirt, straw, slops, dirt, straw, etc. (see photograph, Appendix A).

The distilleries produce 4000 L/d of alcohol, which at zł 17,000 amounts to zł 68 million/d or over zł 21 billion/year. One of the distilleries visited has an elevated tank from which farmers take slops for agricultural land application. The distillery also has a settling tank where the wastewater from

washing potatoes is clarified and recycled. At another distillery, all wastewater appears to be combined and put through a similar four-chamber clarifier, settled, and dumped into a nearby creek.

LEM observed that the problem is one of management. For example, the slops can only be disposed on land during the growing season. Therefore, there should be some monitoring of the doses—although it is unclear who has jurisdiction to regulate land application, agricultural runoff, etc., a point that needs investigation. An information and training program should be undertaken to enlighten farmers about the adverse effects of runoff. (However, the chances of convincing people to change their practices by appealing to their environmental conscience are generally small anywhere, so Namysłów should not count on any large-scale successes here.)

The real problem for the distilleries appears to be in disposal when there is no demand for irrigation with slops. LEM team members observed slops being dumped in land depressions, or hidden in bushes, often along with solid waste and construction residue. This is a serious threat to the environment. The so-called compost heaps of multilayered material do not seem to be in effective use. In some cases the slops end up being combined with wastewater and dumped into a nearby creek. Treatment should be implemented, or the distilleries should attempt to separate the slops, wash water, and any other streams so that the slops are contained for further handling.

Handling combined wastewater[16] should involve a formal treatment plant designed with a deep anaerobic, uncovered lagoon, followed by a sequencing batch activated sludge reactor in a lagoon setting or in a tank. Figure 2.9 shows a simple design, which—for a flow of 100 m^3/day of combined, concentrated distillery wastewater—would provide adequate effluent quality at a capital cost of zł 2-3 billion, built with local equipment. The distilleries, with an annual revenue of zł 20 billion, could well afford treatment plants. Such plants should have a polishing pond (with 15-30 days retention time) and send the effluent trickling through stones and rooted vegetation, to reduce the threat of algal growth being discharged to the stream. The plant could also service other waste streams; if other streams were combined, the reactor sizes might have to change but the concept would remain the same.

2.5 Contribution of Proposed Project in Improving Health Conditions

The wastewater treatment projects already conceived by Namysłów, with improvements suggested by LEM, will contribute in the following ways to the health of the gmina.

1. Savings suggested by LEM in the construction costs of the main STP will allow the gmina to redirect some of the funds into the most urgent public health areas in the rural part of the gmina.

[16]The LEM team learned that at one distillery, there is a small livestock operation and a horticultural enterprise—all parts of the same cooperative-run business. Thus, "combined" wastewater in this case could include animal waste from the livestock operation, domestic sewage, etc., in addition to distillery discharges.

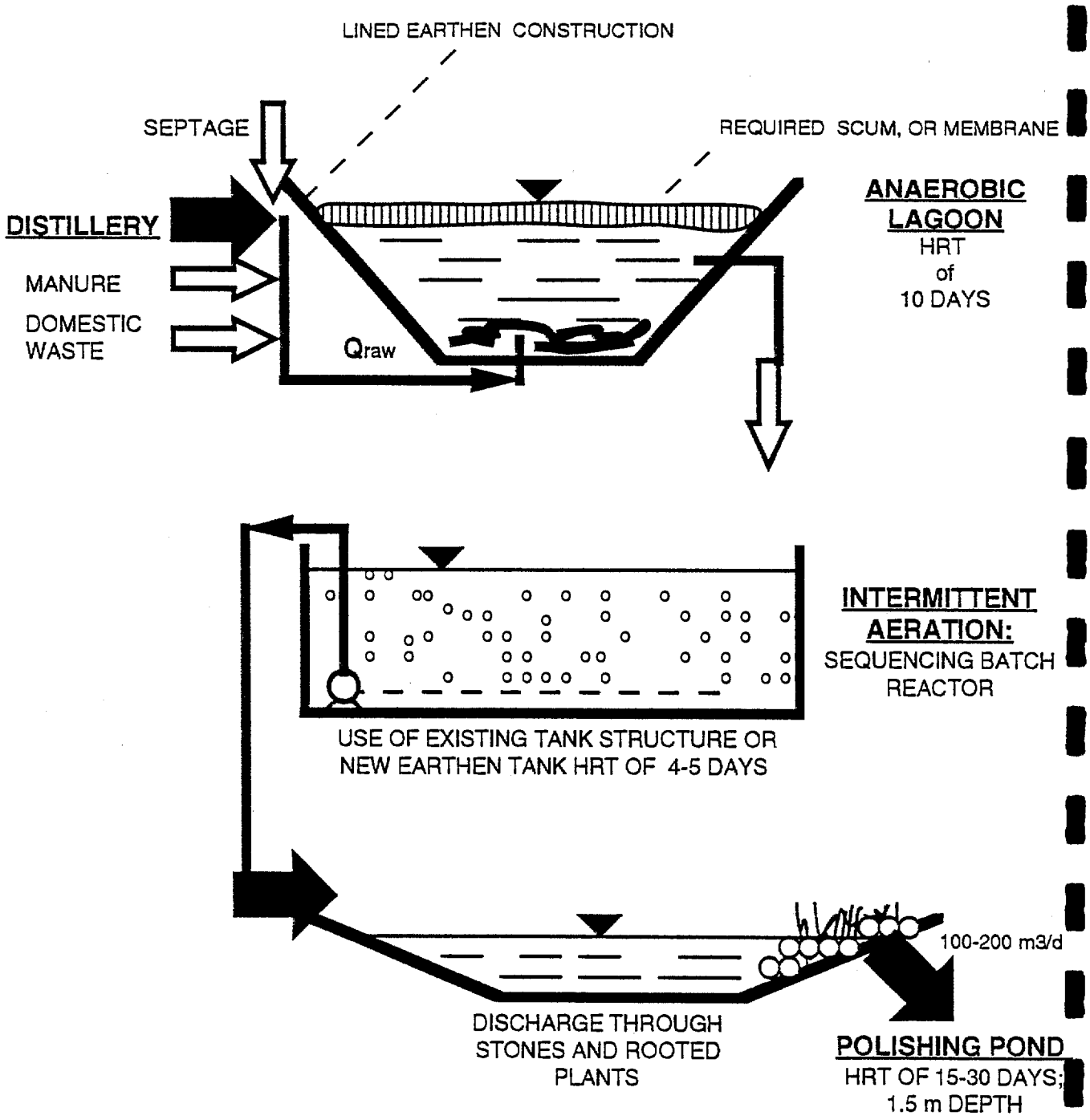


Figure 2.9 LEM proposal: Treatment plant for a rural distillery

(Other wastewater streams from the integrated farm can be included in the treatment plant)

2. The construction of the new treatment plant will make a major contribution to the cleanup of the Widawa River, which has long been affected by discharge of strong primary effluent from the city—and which was recently designated a potential future source of potable water. LEM advised on how to make the plant operate successfully and without interruptions.

3. Solution of the sludge management problem at the STP will minimize operators' contact with the sludge. The method chosen is aerobic sludge stabilization with intermittent anoxic stirring to recover alkalinity, and with intermittent thickening and decanting. This method offers a high degree of sludge stabilization and pathogen kill; after dewatering, the sludge will be acceptable for disposal at the municipal solid waste landfill.

4. Any of the three LEM options for processing of ZPZ wastewater would eliminate a serious threat to the aquifer that supplies most of the drinking water for the town of Namysłów. The options are practical and could be gradually implemented based on available funding.

5. Illegal connections and leaking holding tanks, as well as poorly located wells, create a health threat in the rural areas. A treatment system has now been selected for the village of Głuszyna, with LEM participating in the bid selection process. LEM's series of steps and recommendations regarding technology for dealing with the problems of small domestic wastewater point sources will facilitate removal of this health hazard.

6. LEM supports the development of an updated, comprehensive, and coordinated 5-year implementation plan for wastewater treatment in the rural villages. The improvements in agency coordination and the data collected under this plan would help the gmina to address environment-related health conditions more systematically.

7. Uncontrolled discharges from the distilleries, runoff of animal wastes and distillery slops from irrigated fields, and application of fertilizer contribute to the deterioration of the surface and groundwater resources in the rural part of the gmina. To address this problem, LEM suggested a method of treating the wastewater from privatized cooperatives in a series of ponds providing secondary effluent quality, upgradable to tertiary quality. The proposed solutions heavily emphasize simplicity of construction and ease of operation.

3 MANAGEMENT ANALYSIS

The management analysis presented in this chapter is largely an overview of management in the gmina, with environmental concerns—namely, water and wastewater—placed within this overall context. Thus, the chapter comprises the LEM team's understanding of gmina organization and reporting systems, plus the background and structure of the Namysłów Water Company. Additional components include a critique of management effectiveness, and short- and long-term recommendations.

3.1 Organization and Management of the Municipality

3.1.1 Legal Basis

The primary legal basis of the gmina of Namysłów is an amendment to the Constitution of Poland and six laws that implemented the new constitutional amendment. The amendment authorized the delegation of significant responsibility and power to gminas—the traditional local government unit in Poland. The six laws set forth the specific powers delegated to the gminas and create the legal basis for local government political structure.

The implementation statutes left broad discretion to Gmina Councils (the local political body directly elected by citizens) to devise local laws that define the gmina organizational structure, the powers and responsibilities of gmina departments, and the amount of power and responsibility to be vested in the Gmina Executive.

The constitutional amendment was passed in March 1990 and the six implementing laws were all enacted by May of the same year.

The most significant of the implementation laws is the Local Self-Government Act (LSGA). This law and the gmina local by-laws form the key framework for the organization and management structure of the gmina. The key local by-laws are Resolution XIII/108/91, which establishes the organizational structure of gminas, and the Statute of the Gmina of Namysłów (29/90), which allocates powers and duties to various offices and sets the procedures by which the gmina will conduct its affairs.

3.1.2 Management

The governing body of the gmina is the *Gmina Council*, which consists of 27 members elected by districts for a 4-year term. LSGA Article 15 states, "the Gmina Council shall be the decision making

Previous Page Blank

and control authority in the gmina..." The Gmina Council—as might be expected in an agricultural community—includes a physician, two veterinarians, a lawyer, several active farmers, several engineers and economists, and several residents in the trades, specifically metalworking, mechanics, tire retreading, and forestry. Two of the gmina councilors are women; one is a lawyer, the other an economist.

The Gmina Council elects the Mayor, who need not be a member of the Gmina Council, by secret ballot. It also must approve the Mayor's selection of the two Deputy Mayors. One Deputy Mayor supervises the Technical Affairs Department and the other Deputy Mayor supervises the departments providing civic and social services. Similarly, the Gmina Secretary, who serves as the administrative head of the City Office, is named by the Mayor and approved by the Gmina Council. The Mayor and Deputy Mayors are compensated and are able to devote full time to their official duties. They each serve 4-year terms.

Under the LSGA, the Gmina Council retains certain nondelegable powers. Among these are:

- appointing and recalling the Gmina Executive or any of its members;
- approving the gmina budget;
- passing local land-use plans;
- making major decisions on the purchase, sale, lease or mortgaging of real estate;
- issuing bonds; and
- establishing joint stock companies.

The Gmina Council's power to recall the Gmina Executive or any one of its members is exercised through secret ballot. In exercising its budgetary powers, the Gmina Council may increase or decrease the appropriation for any of its activities, but in the event of an increase, the Council must reduce other portions of the budget to ensure a balanced budget.

The *Gmina Executive* consists of the Mayor, the two Deputy Mayors, and the four members of the Gmina Council elected by the Council members. Like the Mayor, the Gmina Council members of the Gmina Executive are elected by secret ballot. The Mayor chairs the Gmina Executive.

The current Gmina Executive includes one active and one retired farmer, two mechanical engineers (one of these is the Mayor), a sanitary engineer, a surveyor (the Deputy Mayor for Technical Affairs) and a physician (the Deputy Mayor for Civic and Social Affairs). The Treasurer and Gmina Secretary take part in Gmina Executive activities, without a vote.

The functions of the Gmina Executive are spelled out by Article 26 of the LSGA, which defines it as an executive body responsible for implementing the resolutions of the Gmina Council, and for other tasks as defined by law. Important statutory responsibilities of the Gmina Executive include management of property, implementation of the budget, and hiring and dismissing heads of gmina organizational units. The Namysłów Gmina Executive's powers derive largely from resolutions enacted by the Namysłów Gmina Council, which has placed a high degree of management responsibility into the hands of the Mayor and his deputies.

The Gmina Executive, including the Mayor and the two Deputy Mayors, makes major operating and policy decisions for the gmina. It meets on a regular schedule, usually every week, and is the key management body of the gmina.

The key management tier in Namysłów consists of the *Mayor,* two *Deputy Mayors, Gmina Secretary,* and *Treasurer.* Of these five positions, two are not on the Gmina Executive: the Gmina Secretary and the Treasurer. Although neither of these two persons is entitled to a vote with the Gmina Executive, both attend and take an active part in the Gmina Executive meetings. As noted above, the Gmina Secretary and the treasurer is appointed by the Gmina Council upon a motion made by the Mayor; there is no fixed term for this position. The current Treasurer has worked for the gmina for 20 years. This five-member team manages the gmina and the work carried out by the public, quasi-public, and private organizations that perform public functions for the gmina. In addition, the Mayor and Deputy Mayors carry on a dialog with the national government through their contacts with the voivodship office directly and with the gmina's representatives in the Local Self-Government Council. All five incumbents have been in their positions since 1990. They have worked to manage the implementation of the new local government structure, and to take advantage of the flexibility the new laws provide in changing the methods of municipal service delivery.

The Gmina Secretary, a full-time employee, is responsible for administering the "City Office." The various departments of the Office are shown in Figure 3.1 above the dotted line. In addition, the Gmina Secretary is responsible for the Organizational Department, outreach and disseminating information to the public. The gmina's efforts at marketing itself also fall under his jurisdiction. The Gmina Secretary plays a key role in the gmina's operation.

Within the City Office departments and organizational units, there are relatively few (69) direct employees, whom the Mayor is responsible for hiring. Of these, the major concentrations are 14 in the finance function, 6 in municipal economy and environmental management, 9 in civic services. This number includes 8 staff members whose salaries are funded by the voivodship to carry out voivodship services in the gmina.

3.1.3 Relationship with Other Levels of Government

Voivodship

Poland is divided into 49 voivodships, which are administrative units of the national government. Namysłów is one of 65 gminas that comprise the Opole voivodship. Virtually all of the gmina's contact with the national government is through the voivodship in Opole. In addition to grant and loan making, finance, and regulatory functions, the voivodship and the gmina have forged new relationships since 1990. This is a consequence of the national policy of decentralization and delegation.

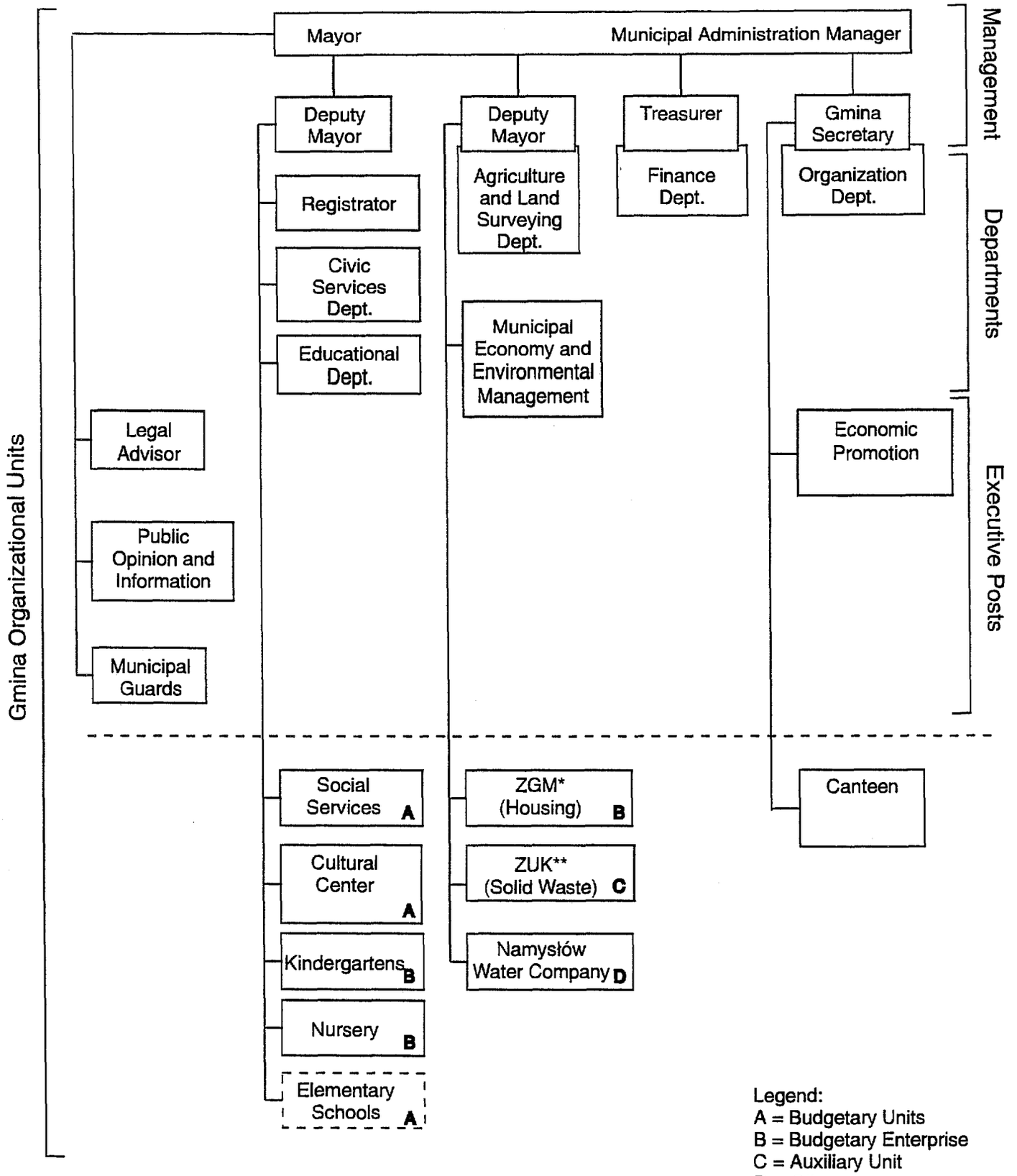


Figure 3.1 Organizational diagram of the Namysłów City Office

Under the 1990 laws, the gmina has begun to perform certain tasks previously performed by the state administration. These are categorized as "mandatory tasks," which national legislation required to be delegated to the gminas; "optional tasks," which the national government authorized gminas to perform; and "contracted tasks," which the gmina and voivodship may agree to have performed on a contractual basis. Table 3.1 illustrates the types of tasks that fall into each category in Namysłów. The gmina also receives funds from the voivodship to pay for the staff necessary to perform certain functions which the voivodship mandates.

National and Regional Government Units

In addition to relationships with the voivodship, certain national government ministries have offices in the voivodship that are characterized as "special administrative units." These units are not under the control of the voivodship. An example is education; the School Superintendent reports directly to the Ministry of Education. Currently, the principal nonvoivodship environmental agency with responsibilities related to Namysłów is the Regional Water Management Authority (Wrocław), which has comprehensive water resource planning responsibilities in the Upper Odra Watershed.

Villages

The Namysłów gmina has 32 villages. These are small settlements that range in population from 40 to 940 people. Of the gmina's population of 26,600, approximately 10,300 people live in the villages. The villages are usually surrounded by agricultural land and some forest. Traditionally, these villages have housed agricultural workers. The village system and land use controls that prohibit the use of high-quality farm land for anything but agriculture have fostered the continuance of this pattern of rural life.

All villages are governed by the gmina and have no legal status as political or administrative entities except for a traditional form of governance used for the collection of the Agricultural Tax. The gmina is divided into *sołectwa*. Each sołectwo elects an official called the *sołtys*. These officials have had the responsibility for collecting agricultural taxes since the 18th century. The LSGA and the other local laws have left this system intact. The sołtys often serves as an intermediary between the City Office and the rural areas. This traditional system continues to flourish concurrently with the district Gmina Council system.

Table 3.1

CHARACTERIZATION OF GMINA'S ORGANIZATIONAL UNITS BY FUNCTION PERFORMED

Type of organization unit	Characteristics								
	Characteristics and Function (no. of employees, people served, numbers or type of person served)	Governance (by mayor's appt., own board, others)	Funds Received from Gmina, 1993		Own Financing? (disbursements, receipts)	Fin. Account Able to Be Audited?	Own Hiring Authority?	Supervising Agency	Comments
			Gmina zł	Other-source zł					
A: Budgetary Units (Jednostki Budżetowe)									
City Office Departmant of Municipal Economy and Environmental Management	9 staff. • CD • Utilities • Facilities improvements • Environmental inspections • Grants and loans • Land use planning	Head of dept. reports to Deputy Mayor for Technical Affairs. Appointment by Mayor. Indefinite term.			No	Treasurer	No	Regional Financial Control Board	
Agriculture and Land Surveying	City Office	Head of dept. is Deputy Mayor for Technical Affairs.			No	Treasurer; Financial Control Board	No		
Economic Promotion	Economic development. Two employees.	Reports to Gmina Secretary. Appointment by Mayor.	3		No	Treasurer	No		
		Deputy Mayor. Appointments by Mayor.	3		No	Treasurer	No		

Type of organization unit	Characteristics and Function (no. of employees, people served, numbers or type of person served)	Governance (by mayor's appt., own board, others)	Funds Received from Gmina, 1993		Own Financing? (disbursements, receipts)	Fin. Account Able to Be Audited?	Own Hiring Authority?	Supervising Agency	Comments
			Gmina zł	Other-source zł					
B: Budgetary Enterprises (Zakłady Budżetowe)									
Housing (Zakład Gospodarki Miejszkaniowej [ZGM])	32 employees. Manages 1511 residential units, 130 commercial units, 167 garages.	Manager appointed by Gmina Executive (and has power of attorney of Gmina Executive)	zł 2.876 bil.	Rent: zł 7.517 bil. Heat: zł 1.915 bil.	Yes	Treasurer	Yes	Gmina Executive. Operates under National Housing Law, which sets housing rents. Commercial rents set by negotiation.	Started 1991 (organization communalized)
Kindergartens	186 employees. 970 children.	Gmina Executive	Fees: zł 10.4 bil.	zł 2.7 bil.	No	Treasurer	Not available	Gmina Executive and School Superintendent. The Superintendent's Office is a part of the Ministry of Education. It does not operate through the voivodship, but is independent.	Started 1990
Nursery	Daycare for children 8 months to 3 years old. 35 children. ____ employees.	Gmina Executive	Fees: zł 1.0 bil.	Not available	No	Treasurer	No	Gmina Executive and voivodship agency for mother and child welfare	

Type of organization unit	Characteristics and Function (no. of employees, people served, numbers or type of person served)	Governance (by mayor's appt., own board, others)	Funds Received from Gmina, 1993		Own Financing? (disbursements, receipts)	Fin. Account Able to Be Audited?	Own Hiring Authority?	Supervising Agency	Comments
			Gmina zł	Other-source zł					
C: Auxiliary Units (Zakłady Pomocnicze)									
Solid Waste (Zakład Usług Komunalnych [ZUK])	27 employees. Services: • General cleaning • Public facilities • Solid waste disposal • Landfill maintenance Served: • 2430 individuals • 4010 commune inhabitants • 8000 village inhabitants • 56 institutions • 42 private companies	Gmina Executive appoints director	1051	ZGM: 591 Institutions: 1348 Individuals: 294 GAZ: 32 Others: 125	Yes	Treasurer	Yes	Gmina Executive	Started 1991. The Gmina Council, via Resolution XVII/29/91, created ZUK to take over assets, liabilities, and work of the state-owned Communal Services Enterprise
D: Other (Inne)									
Namysłów Water Company (Wodociągi Namysłowskie)	48 employees. Serves or plans to serve city and all villages with water and/or sewer systems.	By shareholder - the Gmina Executive	0	Rates and misc. zł 11.2 bil.	Yes	Accountable to shareholder	Yes	Board of Directors	Started 1992

3.1.4 Classification of Gmina Organizational Units by Budget Type

The gmina carries out a large number of significant functions through what are analogous to wholly owned or partially owned subsidiaries (see Figure 3.1). Each of the units is responsible to a particular officer within the City Office.

The gmina categorizes subsidiary organizations into four types. The characteristics of each are described below; the letter designation is the label used to characterize each type of unit on the organizational chart shown in Figure 3.1.

Type A. Budgetary Units. These are funded completely by gmina appropriation. The City Office is one of the budgetary units.

Type B. Budgetary Enterprises. These are funded partly from their own sources. This category includes the Nursery, Housing, and Kindergarten enterprises. In each of these units, own-source revenue is collected and retained by the unit. Annually, each unit must prepare a budget to be verified by the gmina Treasurer. Gmina budget disbursements to units are based on approved budget and cash flow needs. Each unit has its own treasury and accounting function.

Type C. Auxiliary Units. This type of unit receives no subsidy. The Gmina Executive is informed annually of the Auxiliary Unit's revenue requirements and expenditure budget. These require the approval of the Gmina Executive. In addition, 50% of any profits goes to the gmina. However, the Auxiliary unit can request a waiver if the profit is to be reinvested in the Auxiliary Unit. The Auxiliary Unit's employees are employees of the gmina; the unit manages its own payroll collections and disbursements. Presently the only large Type C unit is ZUK (Zakład Usług Komunalnych), which provides trash disposal and cleaning services to the gmina.

Type D. Type D is a limited-liability company in which the gmina can be a shareholder. Presently there is only one such organization, the Namysłów Water Company (NWC), which is discussed in depth in Section 3.2.

A full-time employee serves in the Financial Department to conduct on-site audits of Budgetary Enterprise and Auxiliary Units. The auditor is part of the gmina's financial control system.

Table 3.1 characterizes the units of the gmina by budgetary type, gmina financial contribution, financial accountability, and hiring authority.

3.2 Organization, Management, and Administration of Potable Water and Wastewater Operations

3.2.1 Legal Basis of the Namysłów Water Company

As a result of national government policy decisions to delegate local functions to gminas, the Opole voivodship in which Namysłów is located was required to turn over the ownership and operational responsibilities for the Namysłów water supply function and the sewage collection and treatment function to the gmina of Namysłów. These are facilities that the Opole voivodship previously owned and operated with its own employees. The turnover date was July 1, 1992. In preparation for this turnover of responsibility and assets, the Namysłów gmina made a decision to establish a limited-liability company under the Polish Commercial Code for the purpose of owning and operating water and sewer services in the gmina. In July 1992, the responsibilities for operating the facilities and supervising the employees were turned over to the Namysłów Water Company.

The transfer of the real property of the systems to the gmina from the voivodship has been carried out. In addition, the Gmina Council has approved a resolution authorizing the Gmina Executive to transfer the facilities to the NWC. The Gmina Executive is currently considering the best way to convey the facilities and is evaluating the options of leasing and direct transfer.

The Namysłów Water Company was established by the Gmina Executive, and, the Notarial Deed was signed by the Mayor and a member of the Gmina Executive, acting as representatives of the gmina according to Resolution No. XXI/163/92, which was passed by the Gmina Council on May 14, 1992. The two officials, acting in their capacity as officers of the gmina, executed and filed the documents creating the NWC in the Office of the Notary Public.

The governance structure of the NWC consists of three levels: the Board of Directors, the Board of Supervisors, and the Shareholder(s). The gmina is the sole shareholder of the company, as specified in the notarial deed. Acting in its capacity as the shareholder, the Gmina Executive appoints the members of the Supervisory Board for terms of 3 years, except in the first year of operation (July 1, 1992 to June 30, 1993). For this transitional period the members of the Supervisory Board were named in the notarial deed. This first Board of Supervisors consisted of an official of the voivodship agency that was turning the facilities over to the company; the Director of Environmental Planning, at the Opole Voivodship Office, and the Manager of the Community Develoment and Environment who reports directly to the Deputy Mayor for Technical Affairs. Similarly, the notarial deed named the Board of Directors and appointed a President and Vice President for Technical Issues. Presently these are the only two members of the Board, although there is discussion of adding the NWC's Chief Accountant. The Vice President was previously a technical manager of the voivodship agency that operated both the water and the sewer service function in the gmina and directly supervised water and wastewater operations in Namysłów.

The Namysłów Water Company is given very broad powers by its charter. It is authorized to perform all of the functions necessary to operate, maintain, and extend the water supply and wastewater systems in the gmina; to engage in equipment and transportation services; to repair machinery and water and sewer facilities; and to provide technical and economic advisory services.

While the NWC has broad powers and the gmina has the right to dispose of some or all of its shares in the company, the prime responsibility of the NWC is the provision of water and sewer services to the inhabitants of the gmina. This requirement is specifically articulated in the notarial deed. Changing this requirement cannot occur without the Gmina Executive's approval, even if it reduces the number of shares it holds or gives up holding any shares.

In recognition of the fact that the NWC is carrying out a public mission and because the gmina is the sole shareholder, the assets of the systems will be turned over to it without charge.

In establishing the NWC, the gmina considered several factors. It evaluated the options of running the water and sewer function as a Budgetary Enterprise or as an Auxiliary Unit. In evaluating its organizational options, the gmina hired a business consulting firm based in Opole with staff experience in working in a City Office and with water management as well as with business restructuring and real estate valuation. The principal reason for choosing a limited-liability company to operate the water and sewer systems was a judgment that this form of organization was the best option to secure the gmina's objective of accelerating the gmina's capability to invest in infrastructure.

The key decision makers in the gmina believed that in both the short and the long term, the citizens of the gmina would shy away from making the system investments that the gmina leadership felt were necessary. They also believed that the salaries required to attract and retain quality staff could more easily be established in a corporate environment. The limited-liability company option provided the gmina with a vehicle to spur system investment while maintaining policy and economic control of these key utility systems. One option that the limited-liability company created was the potential for raising future capital by selling additional shares either to citizens or to investors. There are no plans to do this currently.

In terms of financial efficiency, a negative aspect of using a limited-liability company for water and sewer services is the requirement that the NWC, like any other Polish corporation, pay corporate taxes to the national government. For the first year of operation, these taxes are estimated to be zł 8.2 million (Table 4.6, Chapter 4).

At the time of the LEM team's visit, the assets of the water and sewer system had been transferred from the voivodship to the gmina, which was evaluating the most appropriate method to grant the same assets to the NWC. One consideration of this evaluation was the potential property tax liability that might occur if the system assets were held directly by the NWC.

3.2.2 Management Structure of the NWC

The management of the NWC has three levels (see Figure 3.2):

1. The Shareholder (i.e., the Gmina Executive on behalf of the gmina; since there is only one shareholder, the singular form is used) appoints the Supervisory Board and approves the

budget and rate structure of the company. The Shareholder also appoints the President and, on his recommendation, the rest of the Board of Directors.

2. The Supervisory Board currently has three members—the minimum number. The general responsibility of the Board is to oversee the operations of the NWC on behalf of the Shareholder. Specific responsibilities include:

   - ensuring the integrity of the financial operations,
   - signing employment contracts with Board members and setting Board members' salaries,
   - overseeing the work carried out by the Board of Directors, and
   - suspending Board members if necessary.

3. The Board of Directors manages the day-to-day operations of the NWC and develops and oversees short- and long-range plans for the maintenance, improvement, and expansion of the water and sewer systems and their financing. The Board's term of office is 3 consecutive years, with the exception of the first Board, which was appointed for 2 years. The members of the Board supervise the NWC workforce and make decisions to hire, terminate, discipline, and promote staff.

The NWC is currently organized as follows (see Figure 3.3). The President has overall management authority and supervises the work of the finance and meter-reading staff directly through the Chief Accountant. The Vice President for Technical Issues supervises the operating units of the company. There are five specialized functions under the jurisdiction of the Vice President:

- the water production section, which is responsible for maintaining the water supply and treatment operations;

- the sewage collection and treatment section, which is responsible for maintaining the collection system, the old treatment plant, and the lagoon system;

- the maintenance unit for the water and wastewater systems;

- the technical support section, which provides mechanics, welders, metal workers and electricians to the company; and

- the supplies and transport function, which maintains an inventory and vehicles.

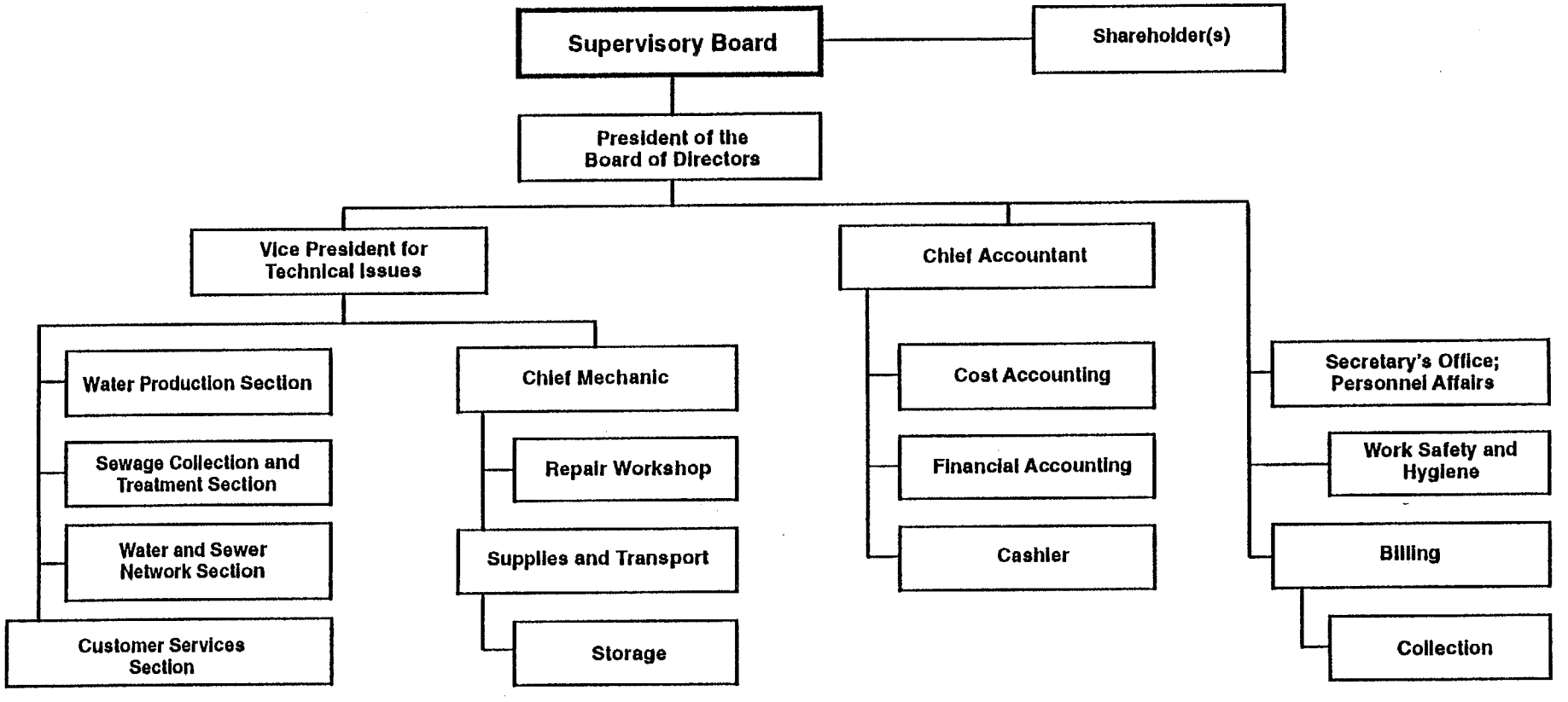
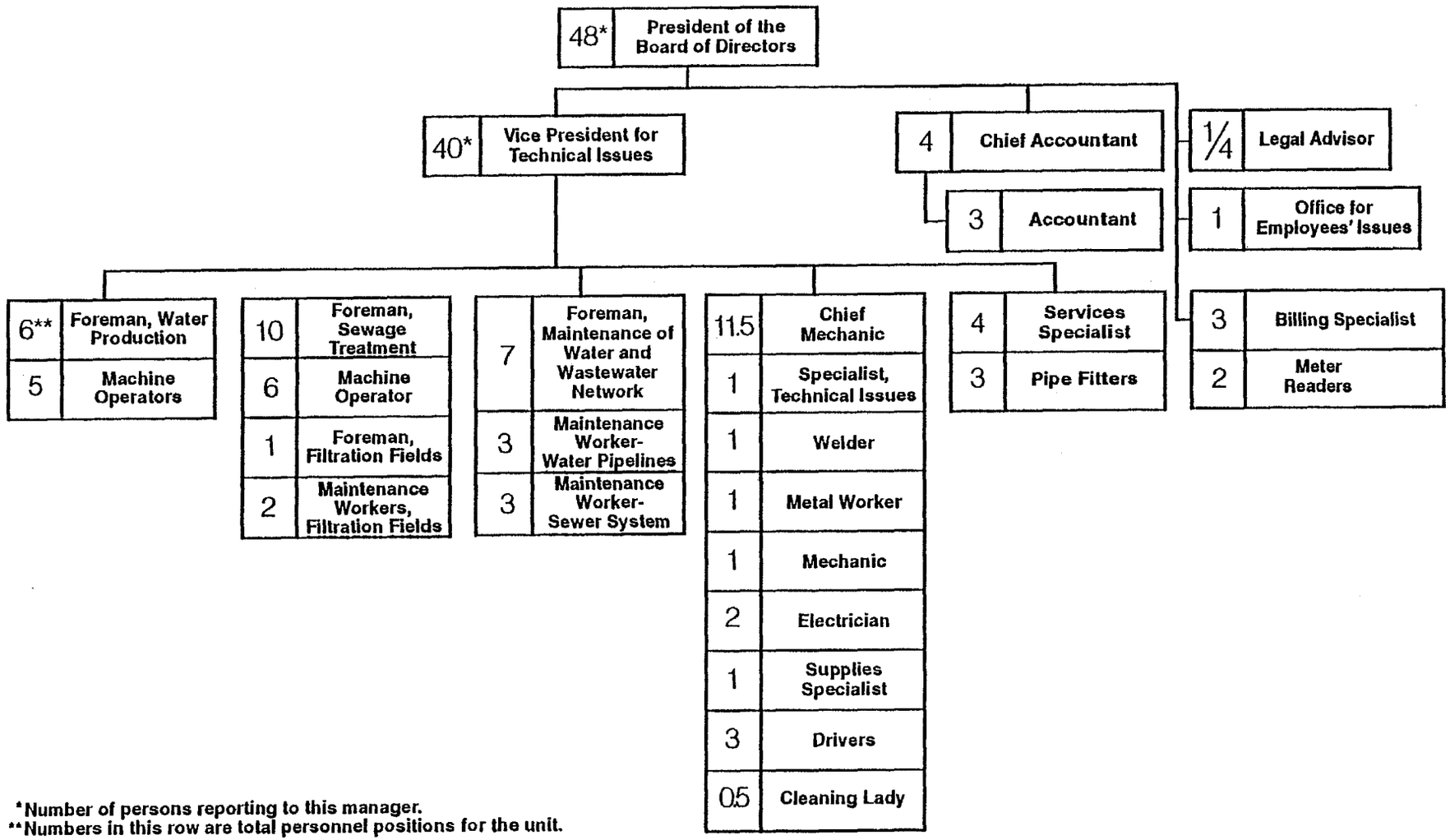


Figure 3.2 Management structure of the Namysłów Water Company



*Number of persons reporting to this manager.
**Numbers in this row are total personnel positions for the unit.

Figure 3.3 Staffing of the Namysłów Water Company

3.2.3 Financial Management Analysis

The financial management of the NWC is the responsibility of the Chief Accountant, who receives management guidance and direction from the President.

It is the practice of the company to read meters and bill customers once a month. Most bills are paid in cash at the cashier's office of the NWC. The exception is the commercial accounts, which usually are paid by bank transfer. The Chief Accountant regularly produces an overdue list. Customers in arrears are contacted by phone, which usually is sufficient to secure payment. The major payment problems are the ZPZ potato processing plant and the health center. These customers represent 5% and 16% of revenue, respectively. Each has a history of chronic late payment. These proportions are significant as together they represent approximately 21% of annual revenue.

The NWC has a computer system that was installed after the turnover of the facilities from the voivodship. It is used principally for accounting applications. Currently the applications running are inventory, fixed assets, meter reading, and billing. Payroll and personnel are the next applications to be added.

The NWC has threatened to turn off water and plug the sewers of local industry to secure collection. This assertive attitude at the commencement of operations has had positive results; except for the two exceptions noted above, there are few long-term delinquencies.

Budgets are prepared by the Chief Accountant in close consultation with the President and the Vice President. The key element in expenditure projection is the use of appropriate measures to estimate the increased cost of electricity, other fuel, supplies, and labor. It is customary for the national Ministry of Finance to provide official inflationary forecasts for different classes of expenditure. These forecasts are published in the *Rzeczpospolita,* the semi-official newspaper of the Polish government, and are used as a guide by gmina officials in setting budgets for the upcoming fiscal year.

After revenue requirements are estimated, they are divided by the estimated number of billing units for each service to be consumed in the forthcoming year, and allocated among sewer, water, and administrative functions. The administrative costs then are allocated to the water and sewer function in proportion to the direct costs of each service. The rates and budget are approved at a shareholders' meeting, with the Gmina Executive acting as the shareholder. Rates established effective January 1, 1993, are expected to be increased effective January 1, 1994.

The NWC and the gmina have a shared policy objective of improving the quality and availability of NWC-supplied potable water to all villages.

Currently there is a general plan to take over the rural water systems and to improve them. There are several approaches to the provision of water to rural villages and a variety of existing systems to be considered. Following are four examples that illustrate the context and approaches being used in Namysłów. (Numbers in parentheses are population figures.)

1. *Water systems built by state companies that have been liquidated.* There is one such system supplying water to four villages: Kowalowice (660), Baldwinowice (60), Bukowa (220), and Igłowice (90). The system will be expanded to serve Smogorzów (500; this project will be financed by the Agriculture Department of the gmina) and Nowy Dwór (200).

2. *Water systems that require new pipelines.* One such system (the Barzyna pipeline) supplies water to four villages: Barzyna (40), Ligota Książęca (1220), Brzozowiec (250), and Mikowice (270). It commenced operation in September 1993. The system was built by the agricultural office of the gmina and financed jointly by the gmina and by a grant from the Polish-German fund. It will be operated by the NWC. The system will be transferred to the NWC on January 1, 1994. Similarly, on January 1, 1994, the Głuszyna pipeline supplying water to Głuszyna (940) and Brzezinki (70) will be transferred to the NWC by the Voivodship Water Services Enterprise. The system will be rehabilitated by the NWC. The cost for replacing these two systems is estimated at zł 600 million.

3. *PGR systems, water services installed by the state farm systems are neglected.* These state farms have been privatized and the private companies have neither the money nor the interest in improving services.

4. *Villages connected to the city system.* Objazda (120; financed by the agricultural department) and Ligotka (120; financed by the Water Company) have been connected; also Kamienna (280), Smarchowice Małe (210), and Smarchowice Wielkie (460).

The rural systems' revenue plan, which has already been approved and implemented, is to establish a single rate for all rural potable water services. This rate will be zł 5200/m^3, or considerably higher than the zł 3000 rate paid by city households.

All services in rural areas are metered and will be billed monthly as they are in the city, except in Kowalowice, where meters are read every 2 months due to low consumption.

3.3 Overall Management Assessment

3.3.1 Efficiency and Effectiveness in Municipal Management

The gmina of Namysłów has taken the delegation of responsibility to gminas very seriously. Under the leadership of the Gmina Executive, the gmina has moved aggressively to improve the quality of service delivery and to make investments in its own future. The gmina has sold publicly held assets and used the proceeds to make improvements to its infrastructure, especially its utility system, with a special emphasis on environmental issues. The gmina has kept the size of the City Office relatively small and has chosen to make use of private or quasi-public organizations to deliver services wherever feasible.

This strategy has led to more rational pricing of services and has enhanced the gmina's capability to provide discretionary services—such as delegated voivodship functions—and to give financial

support to social services such as nursery schools and kindergartens. This financial flexibility is important if the gmina is to play a significant role in either policy or finance in the next major component of delegation, which will be the delegation of primary schools (grades 1-8) to gminas. Although the delegation of this function has been delayed by the new national government, gmina officials expect it to be implemented in a manner in which financial responsibility is shared between the gmina and the Ministry of Education. Gmina officials anticipate more local participation in education policy so that the curriculum is improved and is better tailored to the needs and interests of Namysłów's children, and so that school facilities are upgraded.

Heating in the gmina of Namysłów is provided by a coal-fired district steam heating system that the gmina expects to take over from the voivodship as another step in the delegation process. Although the gmina is interested in taking over the system, it—along with other gminas—is looking into the feasibility of having a single organization operate and manage the district steam systems of several cities. A joint approach is being considered to ensure that the system as whole can support a technical and managerial staff that has the technical skills to properly manage the improvements to antiquated systems and then run the facilities efficiently.

Similarly, the gmina participated in a joint venture with the Voivodship Office to develop and open a sanitary landfill.

In summary, the political and managerial leadership of Namysłów has taken bold and progressive steps in the 3 years since the passage of the Local Self-Government Act. The steps it has taken appear to be economically rational and directed toward building institutions and physical facilities that are key to improving the quality of life and that provide the basis for economic development.

Namysłów recognized early that the absence of a properly functioning STP would be a major constraint on its efforts to expand its manufacturing base, given the new stringent environmental requirements legislated by the national government. Accordingly, Namysłów has correctly viewed the STP as a top priority that is key to addressing both its environmental and its economic goals. Namysłów has already benefited from its decision to build the STP by attracting the German-owned ice cream manufacturing facility, which will employ 125 workers. This would not have been possible without the STP.

Feasibility Studies

Under the design/build bidding system as used in Namysłów, the gmina specifies performance characteristics, and teams consisting of a designer and a contractor then prepare and submit proposals for systems or structures that meet those characteristics.

One major drawback of this system is that it omits feasibility studies or any other objective analysis of alternatives before the request for proposals is announced. Feasibility studies are comprehensive analyses of all the factors that need to be considered as a project is developed. Specifically, they include:

1. Establishing the actual needs to be met by projects so that functional specifications can be determined. For example, for the Namysłów main STP, this would have included flows, loads, seasonal variation in both flow and load, permit requirements, and an evaluation of how these parameters might change during the life of the plant.

2. Examining all facilities that have the potential to be connected to the system under study. In Namysłów, the feasibility study would have examined both the ZPZ and brewery treatment systems more closely to verify treatment loads and estimate the cost-effectiveness of separate vs. combined treatment at the main STP.

3. Identifying policy options (how many plants, what type of connections) and possibly treatment processes.

4. Establishing the capital costs (soft costs such as design, consulting, and legal counsel, as well as hard costs such as land and construction) and operating costs (electricity, gas, parts, labor, laboratory analysis) of each approach.

5. Evaluating the financing options for each approach. Examples might include national government loans, voivodship environmental fund loans, government and foundation grants, and internal sources from the gmina or NWC. It would also examine payment terms and interest rates.

6. Identifying alternative methods of funding operating costs, including examining rate approaches and determining whether it is appropriate to have separate rates for different types of users (domestic, commercial, industrial, government).

7. Identifying the options for managing the facility: a limited-liability company owned by the gmina, like the NWC; a quasi-public organization like ZUK; an operation run by a private, for-profit company; or a budgetary unit.

Analyzing all these parameters at the same time when the project is being conceptualized would give the gmina a solid information base for making important decisions, before it commits to a designer or to a specific technical approach.

This report, particularly the analysis of ZPZ alternatives in Chapter 2 and the financial analysis in Chapter 4, represents aspects of a feasibility analysis. The gmina should use this approach as it makes decisions about ZPZ, wastewater services for the villages, and other large capital projects.

Clearly, many gminas have an acute need for technical assistance at the very beginning of the project development process. LEM, in concert with Polish partners, could establish a methodology, or even a guidebook, to be followed in the project feasibility stage. This methodology would require the inclusion of financial and managerial issues as well as technical ones. LEM could provide expert review of the scope of the studies, suggest the method by which they are to be carried out, and assist the gmina in reviewing the recommendations.

Other Aspects of the Solicitation Process

Because competitive bidding for public works contracts is new to many in Poland in both the commercial and the public sectors, few gminas have the technical resources in-house to handle all aspects of the procurement process for a project as complex as the new STP. In the case of Namysłów, along with technical assistance related to feasibility studies, the gmina might have benefited from help with selection of consultants, expert evaluation of submitted bids, or design of the contract, for example.

Inadequate Data

Scanty preliminary data severely limit designers as they prepare their offers. In Namysłów, the gmina had not done (or authorized others to complete) any detailed preliminary studies to characterize flow or loads, characteristics that must be ascertained individually for each gmina in order to optimize the design. The designer had to work only with permit requirements and limited data from the old treatment plant, the brewery, and ZPZ. This shortage of data contributed significantly to the design problems critiqued in Appendix D.

Similarly, inadequate analysis fostered overdesign of the plant to accommodate unforeseen contingencies. Where well-documented parameters are not available, designers wisely overdesign facilities to hedge against unknown conditions. In Namysłów's case, however, the sewerage system is relatively small. Feasibility studies (like those discussed above) to assess flow and load characteristics and find the optimum solution would not be extremely difficult, and could pay for themselves many times over in construction and operating cost savings. For instance, the size and number of treatment trains, the long HRT, and the requirement that the brewery waste be pretreated before discharge to the STP all resulted in significant construction costs. Components such as these could have been minimized or deemed unnecessary from the beginning of the design phase if adequate flow characterization and analysis had been performed. In fact, the LEM technical analysis demonstrated that pretreatment of brewery waste was unnecessary. (Fortunately, construction of the brewery facilities had not yet begun at the time of this finding.)

Ongoing Communication Between the Designer and the Gmina/Water Company

Namysłów and the NWC were unable to obtain from the designer several key pieces of information, even at the 75% completion stage, that should have been available during design or during the feasibility study if one had been carried out—namely, O&M costs and personnel/staffing recommendations. These requirements of the system need to be known early in the process because (a) they can affect the choice of alternatives, and (b) the NWC needs to be able to establish tariffs for 1994 and future years. The NWC also will need from the designer several months of O&M support after startup, access to expert advice for troubleshooting, and written documentation (instruction manual) for operators.

Coordination in the Environment Area

Namysłów has been both aggressive and progressive in its environmental investment strategy. With additional support from LEM, it could institutionalize the learning from the STP experience and move rapidly toward a more coordinated approach to its remaining environmental problems. One recommendation in this report that pushes the gmina in this direction is to prepare a comprehensive plan for village sewage problems, village water supply, and wellhead protection. In addition, arguments could be made for tighter coordination within the gmina—for example, linking the gmina land-use planning process to the city's environmental agenda.

3.3.2 Efficiency and Effectiveness in Water and Wastewater Management

The water supply and distribution system is managed professionally by a competent staff that has a long history with the system. The NWC has a long-term goal of increasing its dependence on the new, higher-quality well field in the northern part of the gmina, and consequently reducing its reliance on the wells in the southern part of the city that produce poorer-quality water and are more subject to percolation of ZPZ wastes and agricultural runoff. However, the officers of the NWC envision that the southern well field will always supply approximately 50% of the city's water needs.

Until recently, managers of Namysłów's wastewater operations faced only the limited demands of a simple, low-technology treatment system. Construction of the new STP introduced a host of new decision-making and management challenges as described in Sections 2.2 and 3.3.1; the NWC's effectiveness in wastewater management will continue to be tested during the startup, acceptance, and transfer to NWC operation of the new plant. The present leaders of the NWC are anxious to make the plant a success. For example, the President and Vice President of the NWC have recognized the need for a technically trained person to be hired as plant superintendent and the need for rigorous training of operating staff. Concurrently, as soon as a recommended staffing/training plan is provided by the designer, NWC managers plan to evaluate the suitability of existing staff of the NWC generally and the sewage and treatment section in particular.

Despite the progress made in establishing the NWC and privatizing the water and sewer services, the managers of the gmina and the NWC face a difficult set of management tasks. The primary task, of course, is operating the new STP. This effort will be very management intensive; operations will be determined largely by the trial-and-error method unless the designer and/or the on-call expert recommended in this report work intensively during startup and unless the plant has a properly qualified operating staff. The fact that neither the gmina, which is building the plant, nor the NWC, which will operate it, had any specific plans to address startup and ongoing operations was a major concern of the LEM team during its visit.

Similarly, while the gmina did a good job of selecting an STP approach for Głuszyna, no provision had been made as to what entity would operate the Głuszyna facility: private firm, ZUK, the gmina, or the NWC. Staff at the NWC believed they would not have any responsibility for the Głuszyna plant, as they had not participated in the procurement process. Similarly, there were no plans to

involve the NWC in provision of wastewater services to the other villages. In neither case were other management approaches being contemplated.

The gmina should recognize that along with a new STP, it likely will have a high level of wastewater technical expertise, management resources, and utility management infrastructure. This will include a professionally trained plant supervisor, qualified operating staff, an on-call expert, laboratory facilities, and the technical experience of the NWC's Vice President for Technical Issues, as well as a complete utility billing system.

Although the village systems will not require solutions as sophisticated or capital-intensive as the main STP, it makes sense for the gmina to fully use the management and technical expertise it already has at the NWC.

In summary, in developing a comprehensive approach to treating village wastewater, the gmina should capitalize on the expertise in the NWC and also consider how the current staff of the sewage section of the NWC might be called upon for O&M functions in village systems as they are designed and brought on line.

In addition, given that the new STP is not expected to accommodate village septage and still meet its permit requirements, LEM recommends that the comprehensive plan place a priority on evaluating:

- Problems and issues that may arise from the continued discharge of septage to the lagoons associated with the old treatment plant, given that STP effluent will no longer be discharged there, significantly reducing the dilution of septage.

- Evaluate design changes to the STP and changes to standard operational regimes that may enable the STP to treat some septage.

3.4 Recommendations

3.4.1 Short-Term Recommendations: 6 to 12 months, for NWC

1. The NWC must develop valid assumptions about the quantity of water used and wastewater generated by its customers. In the first year of operation, the NWC has seen per capita consumption of water decline from 190 L/person/day to 150 L/person/day, a 21% decrease. The future trend in household consumption patterns needs to be fully assessed, as does the trend in use by its larger customers (i.e., the brewery and the ice cream factory).

2. The NWC must develop a staffing plan for the plant that identifies the skills required to take over and manage the plant effectively. In preparing this plan, the NWC must develop job descriptions for the positions required. These should be detailed enough to identify the specific technical skills and experience required for each position.

3. For development of the staffing plan, the most important job to define is the position of plant supervisor/manager. It is recommended that a profile for this job be developed and a well-thought-out recruitment evaluation and hiring process initiated. The LEM project could provide technical assistance on these tasks.

   Ideally, the plant superintendent should be on the staff of the NWC during acceptance testing so that the designer's working knowledge of the plant is more easily transferred to the plant manager.

   Similarly, the plant manager should be hired early enough so that he/she has the opportunity to work closely with the President and Vice President for Technical Issues in defining, recruiting, and hiring the plant staff.

   As job requirements are developed, it will be important to recognize that although technical skills are of paramount importance, the management and interpersonal skills necessary to work effectively in the context of the NWC also need to be identified and carefully considered in the hiring process.

   The plant's performance will depend as much on the quality of the operational personnel and the sophistication of process control as it will on the design. STP personnel must be thoroughly trained in the process for which they are to be responsible, and the gmina should pay particular attention to the formation of the management team that will include an outside expert available on an as-needed basis, to help diagnose problems and adjust the process parameters accordingly—essential for the ongoing support of the operation. LEM could provide long-range training in addition to the startup assistance and training provided by Hydrosan.

   By filling the on-call engineering advisor and the Plant Superintendent positions early, the NWC also will have the benefit of their advice and insight during the balance of the staffing process.

4. For filling the balance of the positions, the current staff of the NWC should be given the opportunity to apply. Further, during assessment of internal candidates for these new positions, careful consideration should be given to evaluating how intensive training and on-the-job experience could qualify an internal candidate. All appointments of internal candidates who require additional training should be provisional for at least 6 months. In the case of such staff, only those who meet the job performance standards after 6 months should be hired permanently. A similar provisional appointment process, without the training component, should be used for outside hires.

5. In development of the staffing plan, the role of the Vice President should be clarified and strengthened. The current NWC approach is to put the STP under his supervision, as all technical operations, including sewerage, are under his jurisdiction now. If this plan is to be implemented, the Vice President should actively participate in the acceptance testing and turnover process and become familiar with the scientific and operating principles of the plant.

This knowledge is essential to ensure that the Vice President can effectively oversee management of the plant and provide management depth. In the absence of the plant manager, the Vice President should be able to manage both routine operations and emergency situations. Like the plant manager, he should have a working relationship with the on-call engineering expert.

6. The NWC must secure reasonable estimates of the increased operating costs of the STP. In estimating these costs, the company should carefully evaluate the increased costs of electricity, chemicals, and specialized maintenance. By taking over the new plant, the NWC will move from pre-World War II to extremely advanced technology. Indeed, the treatment plant will be the most complex technological function managed by the gmina of Namysłów. In developing revenue requirements for 1994, the NWC must estimate the costs of staffing and operating the new plant. It is recommended that the NWC make conservative estimates—with ample provision for the unexpected events that are inherent in the startup of any complex industrial process—by securing operating cost estimates from the designer along with the designer's recommendations for staffing. This information should already be in the possession of the NWC.

7. In preparing its revenue requirements for 1994, the NWC should assess the reduction in expenses that will occur when the operation of the old system ceases. These reductions may offset the increases required by the new plant.

8. While the staffing plan for the new treatment plant is being developed, consideration should be given to the aggressive water supply plan of the NWC and gmina. The plans to expand the availability of high-quality potable water to villages should not be compromised by focusing management attention solely on the startup of the STP. The NWC is entering a phase where construction and startup activities will peak. During the next 12 months, many villages are scheduled to be provided with water, and the wastewater treatment plant will come on line. After 12 to 18 months, most of the construction work, acceptance, testing, and correction of operational bugs will be completed and operations will become more routine. For the short term, the NWC should consider meeting temporary construction management and project management tasks with temporary staff or gmina staff. This approach is necessary to meet current schedules without overstaffing.

3.4.2 Short-Term Recommendations: 6 to 12 Months, for Gmina

LEM recommends that the gmina:

1. Develop a strategy in concert with other gminas and the appropriate national association of gminas, to seek a parliamentary act exempting from the income tax (and other national taxes related to profit and turnover) public utilities operating as limited-liability companies in which 100% of stock is held by the gmina. This exemption would eliminate the major financial disadvantage of operating the water and sewer functions through a limited-liability company and would increase the NWC's capability to make investments in its systems.

2. Evaluate the impact of property taxes. In considering the method of transferring assets from the gmina to the NWC, the gmina should evaluate the impact of the type of transfer on the NWC's obligations to pay property taxes. If the NWC is required to pay property taxes under any scenario, the gmina should (a) consider seeking a statutory exemption as in #1 above, and (b) evaluate the benefits of maintaining the assets as gmina—and therefore tax-exempt—property. Consideration should also be given to seeking an exemption from property taxes paid to the gmina. This would help build reserves for capital expansion and improvement.

3. Use the current 5-year revision to the land-use plan to delineate protection zones around the water supply sources that the NWC is using or will use to provide potable water to the villages.

4. Use the land-use plan to require properly designed septic systems as a condition of new home or apartment building in the residential areas in the villages and in the unsewered areas of the gmina.

5. Develop a comprehensive plan for managing wastewater in the villages. This plan should use the feasibility study approach described in Section 3.3.1. Two major outcomes of the plan should be:

   - A thorough identification of village-generated environmental and health problems, including the problems with distilleries in Minkowskie, Przeczów, and Smogorzów, described in Chapter 2; and problems associated with any other processing facilities in the villages.

   - The categorization of problems by type and severity (point source discharges, nonpoint threats to ground and surface water). Sources of effluent should be identified as domestic, industrial, agricultural, etc.

   This assessment should identify villages facing the most severe problems and determine which villages have similar types of problems. After this assessment, the gmina should prepare a comprehensive plan for addressing these problems over a 3- to 5-year period. The comprehensive plan should evaluate alternative technical approaches and institutional roles (who builds the facilities, who owns them, who manages them, who pays operational costs, who maintains them).

3.4.3 Longer-Term Recommendations

Looking ahead, it is reasonable to assume that a comprehensive plan for wastewater management in the villages would require several different approaches. These would include approaches tailored to:

- Villages that need and can support a sequencing batch reactor with polishing pond like the one chosen for Głuszyna.

- Villages that can link up with the distillery located in the village for joint processing of distillery waste and domestic sewage, as described in Chapter 2. In these instances, establishing workable and appropriate cost-sharing and management responsibilities among the distillery, gmina, NWC, and village residents will be of paramount importance.

- Villages where at least some groups of dwellings can be linked to a communal septic system.

- Villages or parts of villages where individual septic systems or other "stand-alone" solutions are acceptable and cost-effective.

The comprehensive plan must address the question of the gmina's legal powers with respect to setting performance standards for new village systems, and for existing stand-alone or communal systems. To be effective, the comprehensive plan needs to be based on some standards, which unfortunately do not exist yet. LEM could help the gmina develop them, although the gmina's legal advisor holds the opinion that obtaining the power to establish and administer such standards would require an act of Parliament. This issue and the related issue of the gmina's power to require individuals to participate in a village wastewater management system, especially if there are user fees, needs to be investigated as one of the first steps in the comprehensive planning process. Similarly, the plan should evaluate which of the gmina's institutions is best suited to carry out the plan.

The pattern of capital funding set by the gmina and the NWC appears to be characterized by a desire to have capital costs borne by the gmina out of general revenue or through grants from foundations and the national government—and direct contributions from the business sector, as in the case of the brewery—leaving only operating costs to be recovered through rates. In preparing the comprehensive wastewater management plan for the villages, the gmina needs to have a relatively consistent approach from village to village, perhaps with the exception of the villages with distilleries. The NWC has already done this to some extent in setting a uniform rate for rural water service. The plan should evaluate whether a similar approach is feasible for rural wastewater management as well.

Other long-term recommendations (beyond 1 year) are as follows:

1. Implement the village wastewater treatment program improvement plan. It is reasonable to plan for implementation over a 3- to 5-year period.

2. Develop a regular public communications program for the community about the NWC and related organizations. Provide tours of the new plant to civic groups, and develop a literature package that explains how it works. Have the design and operational features that are unique published in magazines of general interest. The modernity and technical sophistication of the plant could have a spillover effect on public and industry perception of Namysłów as a small but sophisticated community. The plant could be a visible and easily understood symbol of the progress Namysłów is making.

3. Develop a human capital investment program. The work of the NWC is labor-intensive. Most of the company's budget goes for salaries. Developing and implementing a strategy to make all employees as productive as possible and to help them grow in competence needs to be considered as an investment. Technical training for operation of the new plant is extremely important, but training strategies for the 60% of the staff not directly involved in plant operations should be considered concurrently.

Financial Management

The gmina manages its financial affairs in the context of a small city surrounded by farmland and 32 villages of various sizes. Although of modest size, the gmina has a large and complex operation with diverse revenue sources. Total direct gmina revenues will exceed zł 50 billion in 1994. When this amount is considered, plus the receipts of its subordinate units and proceeds of loans and grants, the gmina's revenue flow approaches zł 100 billion.

The absolute size of the gmina's cash flow is significant, as is the complexity of its operation. In many ways the gmina functions like a corporate holding company, with many subsidiaries carrying out diverse functions, all overseen by a small headquarters staff—the City Office.

The emergence of the gmina as the dominant local political entity and the innovative arrangements it has pursued as a result of the decentralization of power has significantly added to the complexity of financial management, while the gmina's financial control and reporting system have remained static. Now almost 4 years after the delegation of major governmental powers to the gmina, it is appropriate to review the financial control system. Several steps are recommended.

1. The gmina should arrange with a private auditing firm that also has financial management systems expertise to provide an annual audit and management review of the gmina. The LEM team understood that the Regional Chamber of Accounts[17] plans to audit delegated functions annually and the gmina only once every 4 years. This is too long an interval to prevent major mistakes from compounding, especially in an environment in which many new institutional arrangements have been created.

2. The auditing firm chosen should be familiar with Polish municipal accounting and with the intergovernmental context in which the gmina operates. Specifically, the firm should understand the gmina's relationships with its subordinate units and with the national government's ministries via the Voivod in Opole.

[17]The Chamber of Accounts is a relatively new organization that is a part of the Ministry of Finance. It has an office in the voivodship in Opole. According to gmina staff, until 1990, audits of the gmina were performed by the Finance Department of the voivodship.

3. In addition to having recognized auditing capabilities, the auditing firm should have financial management expertise so that the results of an audit will recommend improvements in management systems in addition to certifying that statutory accounting procedures have been followed.

4. In the first audit, the gmina should seek a comprehensive review and audit of the gmina and all of its subordinate units. If this approach is used, it may be appropriate for subordinate units to share in the costs of the audit.

5. In addition, the first audit should evaluate which financial functions could most effectively be computerized, with a view toward the feasibility of the Treasurer's office performing some or all of the accounting and treasury functions currently performed by subordinate units. Moving toward more centralized financial administration should provide the opportunity for increased accountability, and more effective use of the finance and accounting employees in the subordinate units and City Office.

6. The gmina should use the results and recommendations of the first comprehensive audit to strengthen its management and financial control systems. In implementing the recommendation, the gmina should consider that it holds primary financial oversight responsibility for all subordinate units, even though these units currently manage their own revenue and expenditure functions.

7. The gmina should develop a budgeting system that clearly separates appropriations for the operations and subsidies to its subordinate units from capital spending. In this approach, capital spending would appear in a different portion of the budget and a separate section of the budgetary resolution. Separating capital investments from the operating costs of the gmina would simplify year-to-year analysis of expenditure trends and would clearly inform gmina officials, and outside observers, of the gmina's financial priorities.

   In implementing this recommendation, several steps should be taken:

   The first step is to define capital spending. Capital spending is frequently defined as spending that will increase the assets of the community and result in an asset which has a useful life of more than 5 years. The new primary school, the village water supply systems, and roads are frequently cited as examples of capital spending projects. However, capital spending is defined by the object of the expenditure, not by the source of funds. For example, the gmina may fund the reconstruction of several kilometers of roads each year, with the understanding that these roads will not need reconstruction for 15 years. These investments should be considered capital spending even though the source of funds is annual general revenues of the gmina. The capital budget of the gmina should include the planning and design portions of projects, the so-called "soft costs" as well as the "hard costs" of construction. It would not be uncommon to see analysis and design costs for a project in a capital budget in one year and the construction costs in the following year.

The second step is to develop a method by which capital projects are identified in the budgetary process and segregated to a separate section of the annual budgetary resolution. This could be accomplished fairly easily by City Office staff in applying the definition of "capital project" to the budget requests of gmina departments and subordinate units.

The third step is to develop a fixed-assets recordkeeping system that maintains a list of all the gmina's assets, especially those that have been created since 1990. This list should be comprehensive, including all capital projects implemented by the gmina and its subordinate units. These fixed asset records should define the project, list ownership, and identify the source(s) of funds including loans, grants, and gmina appropriation. A comprehensive list would help the gmina demonstrate to outsiders and residents the scale of the gmina's investment program and how effective the gmina has been in securing outside funds.

4 FINANCIAL ANALYSIS

The main purpose of the finance survey task was to analyze the environmental operations of the gmina from a financial perspective. Four areas were evaluated: (1) the finance and budgets of the gmina, (2) the finances of the Namysłów Water Company, (3) the financing of the new sewage treatment facility, and (4) the financing options for other proposed environmental projects.

4.1 Gmina Economic Conditions

Namysłów is an agricultural/rural gmina with a significant and diversified industrial/commercial sector. Two-thirds of the land of the gmina is devoted to agriculture but more people work in industry, 31%, than in any other sector. Agriculture represents the next largest employment sector, with 13% of employment. Commerce and service represent the next largest areas. In the past 3 years, there has been significant investment in the community by both the private and the public sector. The gmina is making large investments in infrastructure—in particular, environmental infrastructure such as sewerage, water supply, and solid waste disposal—and industry also has invested in several large projects. In general, as in all of Poland, the agricultural sector has suffered a downward trend in recent years and the commercial sectors are performing relatively better.

As can be seen in Table 4.1, there has been little change in the population since 1989. The current population is estimated at 26,600, with 16,300 living in the main town and 10,300 living in the outlying towns and rural areas. In the past few years, there has been some growth in the population in the town and a loss of population in the outlying areas. This is true for Poland in general. In the gmina, 30% of the population is under 18, and 12% is over 64 or retired. This corresponds closely to 30% and 13% for Poland in general. Over 50% of the population has a vocational, secondary school, or university degree, as compared to 55% for Poland.

Records of the average per capita income or average household income are available through the national government. The Polish Central Planning office estimates that the average per capita amount for Poland in 1993 was zł 4,000,000 per month, or zł 48 million per year. The gmina is generally not as wealthy as the country at large; the estimated per capita income is about 60% to 70% of the national average. At 65%, the average monthly income would be zł 2.6 million, or zł 32 million per year. Average household income is a factor of the number of wage earners, the number of members of the household, and any government transfers. An estimate of average household income is about zł 6 million per month or about zł 72 million per year. No data are kept at the gmina level, so these are only estimates. The rural areas in Poland are generally poorer than the cities, although Opole may enjoy better economic health than other rural areas.

Table 4.1

ECONOMIC AND STATISTICAL INFORMATION

Population			
Year	Total	City	Rural
1988	26,383	15,964	10,419
1989	26,291	15,936	10,355
1990	26,385	16,079	10,306
1991	26,521	16,237	10,284
1992	26,638	16,331	10,307
Projected			
1995	27,480	17,960	9,520
2000	27,900	18,700	9,200

Inflation, in % (data from voivodship and gmina statistical offices)

	National	Voivodship	Gmina
1989			251
1990	600		585
1991	70	70.30	70
1992	44	43.00	
1993	33	36.00	

One of the primary economic bases for the gmina is agriculture. Two-thirds of the land is used for crops and it is the second largest employer. The major crops are wheat, rye, potatoes, and sugar beets. Individual farms are the largest sector of the agricultural economy, representing 36% of the property, a percentage that is lower than for the country as a whole. State-owned farms and cooperatives represent 23% and 5% respectively. As nationally, the size of individual farms continues to be small: over half of all farms are under 5 hectares. The largest cooperative farm employs 110 persons.

The agricultural economy of Poland and that of the gmina has suffered in recent years. This is in part because prices for commodities such as potatoes, on an inflation-adjusted measure, have dropped significantly in the past 3 years. The price of sugar beets on an inflation-adjusted basis has also dropped.

The commercial sector of the gmina is diversified and growing. Employment in this sector has been rising. The main industries are food processing, alcohol brewing and distilling, and agricultural trading. The largest employers are an agricultural processor with 400 employees, a car product maker with 343, the brewery with 225, the potato factory with 145, and the ice cream factory with 125 expected employees.

As in the rest of Poland, the gmina has experienced significant growth in the private sector. The number of private firms has gone from 620 in 1990 to 774 in 1992. This number has increased even more in 1993. The major areas of growth have been in the service and commercial sectors.

The employment picture in the gmina has mirrored the situation in the country. Since 1990, the unemployment rate has increased and currently stands at 20.8% in the gmina. This compares to 14.2% in the country and 13% in the voivodship. However, from April to October 1993, as economic growth in Poland increased, the absolute number of unemployed in Namysłów declined from 3,300 to 3,000. One critical long-term problem for the gmina is finding jobs for the large number of young people coming into the workforce.

There are three banks in the gmina: the Cooperative Bank, the Zachodni Bank, and the Powszecha Kasa Oszczędności (PKO; Polish Savings Bank). The gmina has all of its accounts with the Cooperative Bank, but at one time had its accounts with the Western Bank. The gmina has no loans with any of the banks.

The gmina's investments in environmental infrastructure include a new landfill, a new sewage treatment plant, water and sewer facilities, and improvements in telecommunications. Private sector investment in the community is represented by the new ice cream factory built by a German company, and by businesses' willingness to co-finance environmental projects.

The economy of Namysłów is closely tied to the general economy of Poland. In the early years after the transition, Poland and Namysłów experienced decreases in economic growth and increases in unemployment. Likewise, the Polish economy and the gmina have experienced high rates of inflation in recent years. Inflation, in turn, has caused high interest rates and maturities on loans to be very short—less than 3 years—making it difficult to raise capital for infrastructure, from either internal or external sources. Lower inflation would mean lower interest rates and longer maturities, and these would mean lower-cost funds for large environmental projects. Poland's rising rate of inflation also complicates the budgeting and budget evaluation processes. It affects the nominal growth in spending, as expenditures must be increased even to remain at the same real level. In addition, many items in the budget (e.g., tax rate maximums, wages, and salary and merit increases) are indexed to inflation.

4.2 Gmina Budgeting and Finance

4.2.1 Background

Poland in the late 1980s and early 1990s passed a series of laws redefining the role of its local governments. The main emphasis has been to decentralize many functions formerly controlled by the national government or voivodships. This process has a dramatic effect on the financial and economic situation for gminas such as Namysłów, and in particular, on funding for environmental projects. The financial goal of decentralization is to give local governments more control over their own finances and the allocation of resources for local services.

In theory, the national government's financial goals are to allow gminas to raise more funds from the beneficiaries of local services, to allow gminas to increase local taxes and local tax bases, and to receive funds from the national governments and voivodships in relation to these governments' interest in specific functional areas. In practice, these changes are occurring in Namysłów. As responsibilities are being transferred, the gmina budget is growing, fees for specific services are being implemented and rationalized, local taxes are being increased, and the local tax base is being broadened.

However, the national government still retains a large degree of control over local budgets. It sets maximum fees for many services and controls the local allocation of shared national taxes. The national government also sets the laws and regulations concerning accounting and borrowing, which are well behind the progress made in other areas of gmina finance. Borrowing, which is almost nonexistent, is proscribed by outdated national regulations and by weak financial and capital markets.

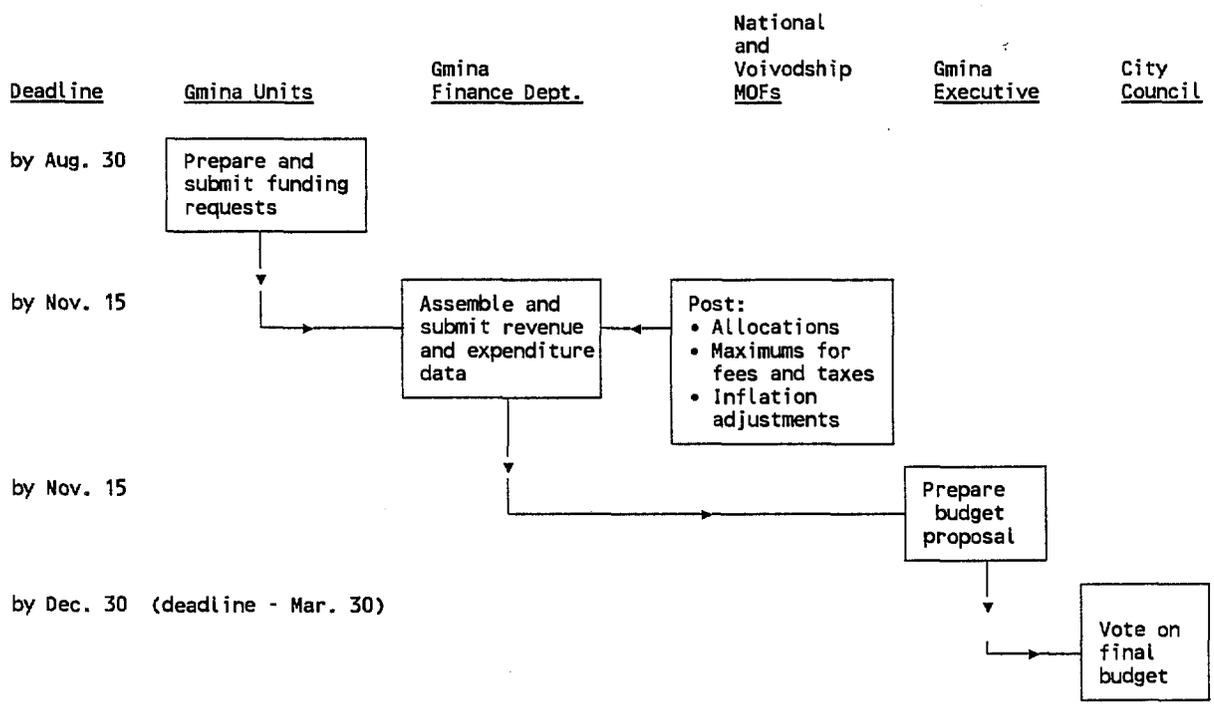
Environmental funding is primarily carried out through two separate gmina units created to provide environmental services. These currently include the Water Company and the solid waste authority (ZUK), and may in the future include the district heating operation. These activities generally are funded through their own fees. However, the financial arrangements described in Section 3.1.4 apply here: In some cases, the gmina owns the unit; in some cases it reviews the fees; in others it simply shares in the profits; and in some cases, investments are funded through the gmina, not through the separate entity.

Because the changes in the local government law occurred in 1990, the team analyzed the budgets since 1991, after the law took effect. This choice represents a time of major change in the operations and finances of the gmina. Before this date, many of the functions now operated by the gmina, particularly in the environmental area, were operated by the national or voivodship governments.

4.2.2 Budget and Allocation Processes

The fiscal year for the gmina is January 1 to December 31. The budget process begins in August of the previous year, when all gmina departments and subordinate units requesting funds present their budget requests for the coming year to the gmina finance department. According to the prescribed process, by November 15, the national Ministry of Finance and the voivodship are to have informed the gmina of its allocations and inputs for the coming year. The national government sets the maximum amount the gmina can assess for certain fees, some taxes, and the adjustments for inflation. The Gmina Executive presents a budget proposal for the following year ro the Gmina Council by November 15, to be reviewed by particular committees. The Gmina Council approves the budget by the end of December; the deadline by which the Council must approve the budget is March 30 of the following year. By 15 November the budget proposal must also be submitted for review to the Regional Chamber of Accounts and the Trade Unions. During the fiscal year, changes are made in the budget as the revenue and expenditure picture changes. There are no set dates for reviewing or adjusting the budget during the fiscal year.

Figure 4.1 Diagram of Gmina Budget Process



In practice, however, the process rarely exhibits such timeliness. The national government invariably provides much of the information on revenues after the start of the fiscal year. While the gmina budget should be approved by the end of December, the budget has been approved as late as March 30th of the subsequent year. The budget undergoes significant changes during the year as revenues and expenditures vary with changes in tax collections, disbursement of funds, adjustment by the national government, and revised estimates on inflation. In 1993, for example, the budget grew from zł 46 billion at the beginning of the year to a projected total of zł 74 billion. The actual budgeting process is a juggling act that the gmina attempts to sustain through nearly continuous changes in the local economy, inflation, national government allocations, and the needs of the gmina.

4.2.3 Gmina Budget

The gmina's budget has expanded in tandem with its increasing responsibilities. Expenditures were zł 29 billion in 1991 and, as stated above, were expected to reach zł 83 billion in 1993. In percentages by year, this represents an increase of 33% between 1991 and 1992 and a very large increase of 106% between 1992 and 1993 (see Table 4.2); a great deal of this increase was due to inflation. As noted earlier, many expenditures and automatic increases in the budget are tied to nominal increases in the rate of inflation.

The listed expenditures of the gmina, however, do not tell the full story of the growth in gmina finances. Many functions once operated by national or voivodship governments are now financed through the nonbudgetary units controlled by the gmina but with separate fee structures, namely water/sewer services, solid waste services, housing, and libraries. Their fees represent a significant portion of total gmina finances.

The gmina allocates a large portion of its funding for investments. This decision reflects both greater local authority and a desire to correct for the many years in which capital needs were neglected. A study of expenditures by Polish gminas titled "Municipal Investment Policy in 1991" shows that gminas in Poland spent from 20 to 30% of their budgets on investments. Namysłów invested 45% in 1991 and 50% in 1992 (Table 4.2), a large part of which went toward environmental projects. The gmina plans to invest about 30% in 1993. Investment spending, however, has relied heavily on funds received from sale of gmina assets, a one-time input.

Revenues

Gmina revenues have grown rapidly, from zł 36 billion in 1991 to the projected zł 82.5 billion in 1993 (see Table 4.3). The main revenue sources are local taxes, subsidies from the national government, other local revenues, shared national taxes, and categorical grants from the voivodship. What has changed for the gmina in the past 3 years has been the structure of its revenue base. Local real estate taxes, for example, have become an increasing and stable revenue source, and national subsidies have decreased.

Table 4.2

NAMYSŁÓW BUDGET FOR 1991-1993: REVENUES AND EXPENDITURES

	1991	1992	1993
Summary (000,000)			
Revenues	35,669	47,439	82,493
Expenditures	28,171	41,339	78,366
Surplus	7,145	9,100	4,127
Annual Increase, Expenditures		46,74%	89,57%
Annual Increase, Revenues		33,00%	73,90%
Investment Expenditures (000,000)			
Expenditures	28,171	41.339	78,366
Including Investments	10,431	12.509	29,121
Investments as Percent of Total Expenditures	37,03%	30,26%	37,16%

Table 4.3

GMINA REVENUES, EXPENDITURES, AND INVESTMENTS, 1991-1993

		1991	1992	Projected 1993
Revenues				
1	Local Taxes	13,337	15,461	23,188
	Real Estate Taxes	5,818	8,065	10,838
	Agricultural Tax	21,904	1,739	4,837
	Transportation Tax	451	1,845	2,671
	Unitary Tax	5,164	3,446	4,480
	Forestry Tax		366	362
2	Local Revenues	14,969	12,940	25,686
	Loan for Treatment Plant	0	0	13,000
	Sale of Property	11,168	12,319	4,396
	Other Revenues	3,801	621	8,290
3	Shared National Taxes	4130	8,550	13,800
	15% of Personal Income Tax	779	7,758	12,483
	5% of Corporate Income Tax	3,351	792	1,317
4	Government Subsidies	3,233	3,343	10,718
	Infrastructure Development			4,332
	Road Maintenance			770
	GOP Subsidy			5,616
5	Surpluses	0	7,145	9,101
	Total	**35,669**	**47,439**	**82,493**
Actual Expenditures				
1	Agriculture	2,617	3,348	2,744
2	Forestry	(5)	36	131
3	Transport	870	160	272
4	Telecommunications			84
5	Public Utilities	10,180	12,837	25,068
6	Housing	1,088	2,771	8,882
7	Education	6,071	9,803	12,373
8	Culture and Arts	886	1,828	2,919

		1991	1992	Projected 1993
9	Health	648	602	1,046
10	Social Services	1,782	3,404	6,399
11	Physical Culture	756	891	1,265
12	Miscellaneous	343	433	1,513
13	Self-Government/Administration	2,935	5,171	9,672
14	Voivodship - Transport			770
15	Voivodship - Infrastructure Development			4,332
16	Interest on Environmental Loan		55	896
	Total	**28,171**	**41,339**	**78,366**
Investments financed by the Gmina				
1	Agriculture	2,602	3,300	2,690
	Water Supply System - Rural	2,602	3,300	2,000
	Lemna Env. Project			90
	Environmental Investments (Głuszyna STP)			600
2	Transport	745		
3	Public Utilities	3,420	7,766	18,006
	Heating Plant Conversion			500
	WTP and STP Bypass	3,000	1,520	
	Sewage Treatment Plant Construction	300	5,721	15,431
	Ziemialowice Landfill		275	
	Gas Supply to C.Sklod. Housing Estate		250	
	Gas Supply to Rural Areas			50
	Construction Works - Krzywa St.	50		
	Construction Works - Pulaskiego St.	70		
	Construct. of Sidewalk - Olesnicka St.			605
	Constr. of Footbridge over Railway			300
	Constr. of Housing Estate Roads			1,000
	Const. of Lighting - Smarchowice			120
4	Housing	3,178	1,229	6,416
	Infrastucture Development (Housing Estate)	378		4,332

		1991	1992	Projected 1993
	Construction of Apartment Building	2,800	1,229	2,084
5	Education			300
6	Culture	350	214	96
7	Self-Government	136		1,613
	Total	**10,431**	**12,509**	**29,121**
	Investments Financed From Other Sources			
1	Agriculture	800	1,402	
	Water Supply System - Rural	800	1,402	
2	Transport			
3	Public Utilities	3,790	2,589	3,410
	WTP and STP Bypass (Funds from the Voivodship Water and Waste Water Utility)	1,800	237	400
	Landfill (Funds from the Voivodship Environmental Fund)	1,990	775	
	Sewage Treatment Plant Construction (Funds from the Brewery and the Voivodship Environmental Fund)		1,577	3,010
4	Housing	1,224	3,172	1,763
	Apartment Building Construction (Funds from the State Insurance Company)	1,224		
	Ice Cream Plant - Infrastructure		3,172	1,763
	Total	**5,834**	**7,163**	**5,173**

The national government still maintains both indirect and direct control over local government spending though its allocation of shared taxes. The government sets the maximum tax rates for real estate and agriculture, the two largest local tax sources, and has direct control over the amount of shared taxes distributed to gminas. In spite of this, Namysłów has made a persistent and relatively successful effort to expand its local tax base.

Although the general budget does fund a portion of environmental spending, about 22% of total expenditures, this amount is mainly for environmental investments; funds to pay for the operations and maintenance for environmental projects are raised primarily through fees charged by the solid waste authority and the Water Company.

Another recent revenue source has been the sale of gmina-owned property. Examples of property sold include apartments, an agricultural company, and a construction company. These sales represented 37% of revenues in 1991 and raised about zł 11 billion that year (Table 4.4). Sales of property, however, are now limited because the gmina has sold off much of the saleable property. Property sales went down to zł 4 billion in 1992, and are forecast to be only around zł 3.5 billion for 1993. However, the gmina has made good use of these sales to invest in other infrastructure, primarily environmental projects.

Direct Taxes

Direct taxes are assessed by the gmina at a rate within a maximum set by the national government.

Real Estate Tax. The largest local tax source is the property tax, which in 1993 will yield about zł 10.5 billion, or more than twice the amount raised in 1991; it represents about 50% of all local revenues. The local real estate tax is levied against both personal and corporate property. There are numerous categories, but in general, the tax is levied against the size of a property, not its value.

Agricultural Tax. The rate for the agricultural tax is based on the number of hectares and the market price of the crop. The agricultural tax represents 20% of local taxes and 5% of total revenues. The gmina has tried to keep the tax low because of the economic problems in the agricultural sector. Because of the ties to the price of the commodity, revenues over time will fluctuate.

Transportation Tax, Unitary Tax, and Forestry Tax. These three taxes represent a relatively small portion of the revenue sources for the gmina. The transportation tax, for example, is assessed against motor vehicles. The unitary tax—a tax on small businesses—and the forestry tax will continue to be smaller revenue producers for the gmina.

Table 4.4

PERCENTAGE BREAKDOWN, REVENUES AND EXPENDITURES, 1991-1993 (in %)

		1991	1992	Projected 1993
Revenue Percentages				
1	Local Taxes	37.39	32.59	28.10
	Real Estate Taxes	16.31	17.00	13.13
	Agricultural Tax	5.33	3.66	5.86
	Transportation Tax	1.26	3.88	3.23
	Unitary Tax	14.47	7.26	5.43
	Forestry Tax	0.00	0.70	0.43
2	Local Revenues	41.96	27.27	31.13
	Loan for Treatment Plant	0.00	0.00	15.75
	Sale of Property	31.31	25.96	5.32
	Other Revenues	10.65	1.30	10.04
3	Shared National Taxes	11.57	18.02	16.72
	15% of Personal Income Tax	2.18	16.35	15.13
	5% of Corporate Income Tax	9.39	1.66	1.59
4	Government Subsidies	9.06	7.04	12.99
	Infrastructure Development	0.00	0.00	5.25
	Road Maintenance	0.00	0.00	0.93
	GOP Subsidy	0.00	0.00	6.80
5	Surpluses	0.00	15.06	11.03
	Total	100.00	100.00	100.00
Composite				
1	Local Taxes	37.39	30.85	28.10
2	Local Revenues	41.96	18.40	31.13
3	Shared National Taxes	11.57	24.46	16.72
4	Government Subsidies	9.06	8.39	12.99
5	Surpluses	0.00	17.90	11.03

		1991	1992	Projected 1993
Expenditure Percentages				
1	Agriculture	9.28	8.09	3.50
2	Forestry	0.01	0.08	0.16
3	Transport	3.08	0.38	0.34
4	Telecommunications	0.00	0.00	0.10
5	Public Utilities	36.13	31.05	32.00
6	Housing	3.86	6.70	11.33
7	Education	21.55	23.71	15.79
8	Culture and Arts	3.14	4.42	3.72
9	Health	2.30	1.45	1.33
10	Social Services	6.32	8.23	8.16
11	Physical Culture	2.68	2.15	1.61
12	Miscellaneous	1.21	1.04	1.93
13	Self-Government/Administration	10.41	12.50	12.34
14	Voivodship - Transport	0.00	0.00	0.98
15	Voivodship - Infrast. Development	0.00	0.00	5.53
16	Interest on Environmental Loan	0.00	0.13	1.14
	Total	100.00	100.00	100.00

Shared Taxes. The second largest source of funds, 19% of 1993 revenues (Table 4.4) is shared taxes assessed and collected by the national government and given to gminas. Prior to 1993, the shared taxes represented the gmina's portion of a "basket" of taxes. Currently, allocations are tied to specific taxes; i.e., the gmina receives 15% of the personal income taxes and 5% of the corporate income tax collected in the gmina. Shared tax revenues are directly related to the community's wealth and its economic performance.

Voivodship Revenues to Gmina. In 1993, the gmina received almost zł 9 billion (Table 4.3) in categorical grants from the voivodship. These are not recurrent sources of finance, but one-time project payments. This revenue source will vary from year to year depending on project funding. However, the voivodship emphasizes environmental projects, which should help Namysłów as it, too, focuses on capital investment in the environment.

National Budget Funds. In 1993, the gmina received zł 1.5 billion as direct grants from the national government, or only 2% of local revenues (Tables 4.3 and 4.4).

Fees. Certain gmina activities—housing, solid waste, water/sewer, libraries—are funded through fees, which amounted to 30% of the gmina's overall revenue in 1993 (Table 4.5), and which do not appear in the gmina's budget. Other fees are assessed for various licenses, for processing of documents, and as interest on bank accounts. These fees do appear in the budget and should be a stable source of funds in the future.

Expenditures

As with revenues, and for the same reasons (inflation and additional responsibility), gmina expenditures have been rising rapidly during the past 3 years (see Table 4.3). As stated earlier, total spending has gone from zł 27 billion in 1991 to zł 74 billion in 1993.

There are three important factors to consider in analyzing the budget. First is the secular rise in budget spending because of the new responsibilities. Second, under Polish government accounting, capital spending and current expenditures are accounted for in the same manner. Therefore, since capital expenditures tend to be large and to occur in single years or over short periods of time, spending in some categories (such as agriculture) is lumpy and fluctuates over time. Third, there is no single account category for environmental spending. Environmental expenditures appear in several different areas, such as agriculture and public utilities. Also, almost all environmental spending by the gmina has been for capital expenditures and, therefore, most of the spending for environmental projects appears as investments or capital expenditures.

The accounting for expenditures is dictated by the national government. The national regulations specify in which areas certain expenditures are made and the broad categories of spending, as shown in Table 4.3. Grants from other units of government or even from private companies may appear in other areas of the budget.

In 1993, the major spending areas were public utilities at 27%, education at 17%, government administration and housing at 12% each, and agriculture at 4% (Table 4.4). Government subsidies also were large in 1993 at 13%, but this is because of two categorical grants from the voivodship. This composite is comparable to the spending pattern for gminas nationwide.

New Responsibilities. One reason for the growth in spending in some areas is the gmina taking on new assignments, such as in education. The gmina now operates the kindergarten and nursery schools and eventually will take over the elementary schools. The education budget has gone from zł 6 billion in 1991 to zł 13 billion in 1993 (Table 4.3). The increase is greater than the rate of inflation, reflecting a determined effort to increase educational spending. Another example is general administration, where the gmina is spending funds improving operations, buying computers, and renovating facilities for running the gmina. Spending has risen from zł 2 billion in 1991 to almost zł 9 billion in 1993. Similar growth is seen in social services, physical education, and communications in the budget in 1993.

Investments. The gmina has dedicated a significant portion of its funding to investments. This is because it wants to emphasize investments and make up for underinvestment in the recent past.

From a financial and economic viewpoint, this decision is sound. Investment spending represented 45% of all spending in 1991 and 50% of all spending in 1992, and is expected to be 31% of all spending in 1993 (Table 4.2). On an absolute basis, spending on investments went from zł 12 billion in 1991 to zł 22 billion in 1993 (Table 4.3). Much of this spending was on environmental projects, judging by the agricultural and public utilities line items. The 1991 fiscal study of gminas indicated that, in the country in general and in the Opole voivodship, capital investments ranged from 20 to 30% of all expenditures.

Environmental Spending. The LEM team's focus was on environmental spending. Over the past 3 years, the gmina has made a significant and continuous commitment to spending on environmental projects, as shown in Table 4.5. In 1991, environmental spending was zł 8 billion and represented 30% of total spending and 65% percent of capital investments. In 1993, the environmental spending was expected to be almost zł 17 billion and to represent 23% of all spending and 75% of all environmental spending. Namysłów has made a serious and continuous commitment to investing its funds in a portfolio of various environmental projects: waterworks, sewage treatment plants, water and sewer hookups, and a new landfill.

Accounting

The accounting procedures used by the gmina, as proscribed by the national government, generate general fiscal information rather than detailed financial data. Thus, the gmina cannot generate a balance sheet, a funds balance, or a flow-of-funds statement. The team is not aware of any general set of accounting standards established by the Polish accounting profession for local governments. Gmina budgets are reviewed by the national Chamber of Accounts of the Ministry of Finance, but this review is more to ensure compliance with national regulations than to promote sound accounting principles. If the gmina wishes ever to borrow from external sources of finance or from banks, it must be able to generate accounts that have been audited and that show a complete picture of the gmina's budgets, assets, liabilities, and cash position.

Borrowing/Debt

The gmina currently has one loan outstanding to the National Environmental Fund, for the construction of the sewage treatment plant. The total amount of this loan will be zł 16 billion. The gmina has no other short-term or long-term debt with other government agencies or financial institutions. Under the Local Self-Government Act, gminas cannot incur short-term debt in any one year that will cost the gmina more than 5% of its income in that year.

Table 4.5

ANALYSIS OF FEES AND BUDGET AND ENVIRONMENTAL EXPENDITURES

		1991	1992	1993
1	**Revenues**			
	Total Gmina Revenues	34,000	44,800	73,500
	Fees/Revenues from Solid Waste	1,800	2,020	2,210
	Fees/Revenues from Sewer/Water		4,500	9,500
	Fees from Other Services (Housing, Schools, etc.)			10,000
	Total Revenues for Environmental Projects	1,800	6,520	21,710
	Environmental Projects as Percent of Total Revenues	5.29%	14.55%	29.54%
2	**Expenditures**			
	Total Gmina Expenditures	26,800	35,700	73,500
	Total Expenditures for Environmental Projects	7,890	16,155	16,722
	Environmental Projects as Percentage of Expenses	29.44%	45.25%	22.75%
3	**Investments**			
	Total Investments	12,110	17,889	22,457
	Total Investments for Environmental Projects	7,890	16,155	16,722
	Environmental Projects as Percentage of Investments	65.15%	90.31%	74.46%

4.2.4 Intergovernmental Finances

Intergovernmental funds from shared taxes, subsidies, categorical grants, and loans, play a major role in the finances of the gmina. However, the higher levels of government affect the gmina's revenues and expenditures in different ways.

Other levels of government exert a strong influence over the revenue pattern of the gmina by controlling, directly or indirectly, as much as half of annual revenues. This category includes shared taxes, which in 1993 accounted for 19% of total revenues; government grants, 14%; and the local direct taxes such as agriculture and real estate whose maximum rates are set by the government, 20%.

However, the gmina has more latitude on the spending side. The major intergovernmental funding source is shared taxes, at 19% of revenues (Table 4.4). While the gmina has no control over how much is provided, it can control how the money is spent. This is not true for categorical grants from the voivodship, which in 1993 represented (combined) about 13% of all expenditures (Table 4.4). The gmina, therefore, has control over the spending of about 85% of its revenue base, a significant amount.

4.3 Namysłów Water Company

4.3.1 Current Services

As described in Chapter 3, the NWC was formed in July 1992 as a local self-government company with the gmina as the sole shareholder. The company was not required to produce an audited financial statement until 18 months after incorporation, or January 1, 1994. It was established to operate the water and sewer systems, to charge rates commensurate with its mission, and to make investments to maintain and develop the water and sewer systems. As a separate company, it has a better ability to rationalize rate structures, operate the facility, and make investments in the company's infrastructure.

Because the company has only one shareholder (the gmina) and no debt, its financial goals are different from those of a regular private company, namely, to charge rates that will cover operating costs, depreciation, and investments. This allows the company more flexibility in terms of rates. The company, however, does have to pay taxes as a private corporation. Consideration is being given to privatizing the company in the future.

4.3.2 Rate Structure

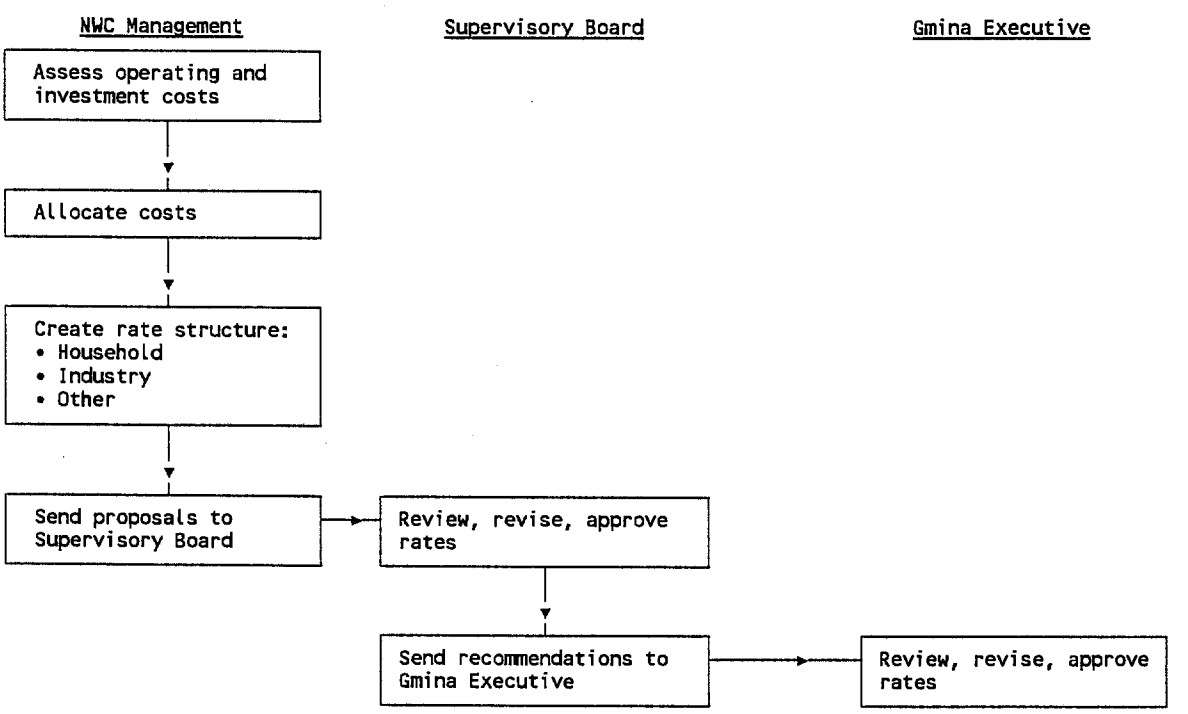
Prior to 1992, water and sewer rates were established by the national government and were subsidized. Therefore, rates prior to 1992 are not comparable to rates after 1992. Management now sets these rates to recover the cost of providing services, based on the type of service, the type of customer, and the location of the customer. In the current rate structure, there are cross-subsidies

between water and sewer rates and between household and industrial rates. Management plans to reduce these subsidies.

Process

The NWC's rate-setting process is first to allocate operating costs and investment costs and then to create a rate structure based on costs for each service and type of customer. Rates are proposed by management and given to the company's Supervisory Board for review. The Board's recommendations are then reviewed by the Gmina Executive, as the sole shareholder of the company; prepared in final form; and approved. The rates were reviewed after the first 6 months of operation and will continue to be reviewed every 6 months.

Figure 4.2 Rate-Setting Process, Namysłów Water Company



Current Rates

The original rate structure for the company on July 1992 and rates in November 1993 are shown in Table 4.6. As with almost all systems in Poland, the rates are broken down into three categories: households, industry, and other. "Other" basically means government entities. The November 1993 rate structure shows that higher industrial rates were subsidizing lower household rates. Further, sewer rates, which should have been higher, were subsidizing water rates. NWC policy is to reduce

Table 4.6

ANALYSIS OF FINANCIAL INFORMATION FOR NAMYSŁÓW WATER SUPPLY SYSTEM

I. Water and Sewer Ratesy	1992	1993	1994
1 Water Rates (zł/m^3)			
Households	2,300	3,000	3,500
Industry	6,600	6,600	7,500
Other	2,800	4,500	5,200
2 Sewer Rates (zł/m^3)			
Households	2,200	3,000	3,700
Industry	3,500	7,500	8,800
Other	2,700	4,700	5,700

II. Income/Expense Statement (000,000)	1992-1993	
Revenues		
Sales of Services and Products	9,323	
Other Sales	178	
Extra Profits	310	
Total Revenues		**9,811**
Operating Costs		
Materials	510	
Energy	980	
Outside Services	544	
Gross Salaries	1,865	
Salary Surcharges	841	
Other	464	
Total Operating Costs		**5,204**
Depreciation	2,658	
Total Costs		**7,862**
Gross Profit		1,949
Taxes	821	821
Net Income		1,128
Ratios		
Operating Ratio		80.13%
Working Ratio		53.04%

III. Estimated Balance Sheet (000,000)

Assets		Liabilities	
Current Assets		Current Liabilities	587
Investments	1,873		
Receivables	1,930	Long-term Debt	0
Material	622		
Fixed Assets		Equity	
Value at Transfer	70,000	Retained Earnings	1,112
(Accumulated Deprec.)	(26,000)	Equity	46,726
Total	**48,425**		**48,425**

these subsidies and make the rates stand alone. For example, rate increases at the beginning of 1993 affected households more than industry, an attempt to reduce cross-subsidization. Rates probably will increase at the beginning of 1994 because of increases in energy and electricity costs. New and higher rates at about zł 5200/m^3 for rural areas will soon be implemented in order to offset the higher costs of providing service to outlying areas.

As rates have risen and people have been charged individually, consumption has begun to fall. This is a positive by-product of higher rates and shows that rationalizing rates can have an impact on consumption. The challenge is in managing the rates in concert with consumption patterns to maximize revenues, operations, and investments.

Comparison to Rates Elsewhere in Poland

Namysłów's water and sewer rates are about average when compared to rates in other gminas. On a list selected by the Water Company President of water and sewer rates for about 40 gminas across Poland, the highest household rate was zł 5500/m^3 and the lowest was zł 1400/m^3. The average is about zł 3000, which is Namysłów's current charge. The range for household sewer rates is from zł 1100 to 7600, with zł 2200 being the average. Namysłów is above the average in this case. However, the survey was based on 1992 rates, which have all increased since then.

Revenues and Expenditures

Total revenues for the Water Company for the first year of operation, July 1992 to July 1993, were zł 9.5 billion. A reconstructed estimated revenue structure is shown in Table 4.7 listing usage and rates. With these revenues, the company was able to cover operating and maintenance expenses, depreciation charges, and taxes, and retain net income of zł 1 billion. This is a return on sales of 12% and on assets of 2.3%. The operating ratio was 80% with a working ratio of 53%, lower than the US average of 65%. Excluding depreciation, which is a non-cash expense, the company was able to generate zł 3.8 billion in cash flow (zł 1.1 billion net income plus zł 2.7 billion of depreciation). This is almost 40% of revenues and will be used for needed capital investments and upkeep. Again, the company's situation is unique because it has no debt costs, nor does it need to provide a financial return to its sole shareholder, which allows it to generate significant cash for investments.

Table 4.7

SAMPLE REVENUE CALCULATIONS FOR SEWER AND WATER FOR THE NAMYSŁÓW WATER COMPANY

Estimated rates based on current rates and prior years' consumption. Rates changed on January 1, 1993

User	Usage Volume (m^3)	Current Rate (zł/m^3)	Revenue
Water			
Households	975,000	3,000	2,925,000,000
Industry	129,200	6,600	852,720,000
Other	129,000	2,800	361,200,000
Total Water	**1,233,200**		**4,138,920,000**
Sewer			
Households	940,200	3,000	2,820,600,000
Industry	454,770	6,600	3,001,482,000
Other	101,150	4,500	455,175,000
Total Sewer	**1,496,120**		**6,277,257,000**
	Total Revenue, Sewer and Water		**10,416,177,000**

Assets and Liabilities

When the NWC took over operations from the voivodship, the assets of the system were transferred to the Water Company. Because the gmina is the owner, the company did not have to pay for the assets. The Water Company, therefore, has no debts or lease payments.

A list of the assets and liabilities is shown in Table 4.6. The assets were appraised at the time of the transfer and valued at zł 70 billion. The major items of value are the pipes and infrastructure at zł 52 billion, the land at zł 8 billion, and the equipment at zł 6 billion. Some accumulated depreciation, currently at zł 26 billion, also transferred when the company took control of the assets. Total assets are zł 48 billion with total equity about zł 47 billion. While the company has the ability to assume debt and increase its financial leverage, the amount will depend on the company's ability to generate cash flow to carry the debt.

Collections

Customers are billed once a month. Most households pay by cash and most businesses pay by bank transfer. The company does not keep a detailed record of arrears on a percentage basis. Almost all customers pay within a 30-day period. Only once has a customer's service been stopped. One company experiencing financial problems and several health services, representing 21% of revenues, do not always pay on time. The company should tighten its policy on regarding delinquencies as "funds in arrears."

Hookups

New customers pay for their hookups but the company, under national regulations, must pay for the meter. The hookup charge is based on the type of pipe and the length of the hookup. The average cost ranges from zł 2 to 3 million. Because there is very little growth in the gmina, the revenues raised through hookups in 1992-93 were only zł 115 million.

Capital Financing Plans

The company has four programs that require capital financing: repairs to the existing system, extension of the current system, a water treatment plant completed prior to the company's formation, and the sewage treatment plant under construction.

To date, the gmina has contributed financing for a number of these capital financing projects. For example, the new water facility was financed equally by the gmina and the voivodship, using no loans.

Over the long term, however, because of (a) the huge outstanding infrastructure needs, and (b) the NWC's capacity to assess user fees, it makes more financial sense for the NWC to fund as many

capital projects as possible and to include these costs in its rate structure. As an illustration of the level of financing that will be needed, during 1993, the NWC was expected to make almost zł 3 billion in capital investments. In the first year of operation, the water system received first priority; the sewer system will receive attention in the second year. Compared to the entire system's investment requirements, however, the zł 3 billion will only make a start. The NWC's fee structure means that it is far more likely than the gmina to have a sustainable source of income for continuing these investments. All of these costs that can be borne by the NWC, therefore, should be borne by the company.

4.4 New Sewage Treatment Plant

The problem of the absence of feasibility studies prior to construction has echoes in the financial aspects of the main STP project. Although financing for the nearly completed plant was successfully arranged by way of grants and loans from national and voivodship environmental funds, gmina sources, and brewery contributions, no studies were done beforehand of alternate construction costs, projected operating expenses, debt service costs, or affordability. Instead, the gmina gave considerable weight to the designer's guarantee to arrange whatever financing was required.

The gmina does own the plant and these assets will be transferred to the Water Company when the company begins operating the plant. The brewery will contribute its share, 46%, through the gmina. The Water Company will assume the responsibility for operating the plant, but a decision has not been made on whether the Water Company or the gmina will be responsible for the gmina's portion of the debt service payments.

4.4.1 Capital Costs

The total cost is expected to be zł 60 billion. As noted above, the brewery will pay 46% of this amount.

4.4.2 Financing

Initially, the treatment plant was to be a joint project among the potato processing plant (ZPZ), the brewery, and the gmina. The potato factory was to be responMwble for 68% of the costs, the brewery 20%, and the gmina 12% (see Table 4.8). The original plant was to have cost zł 89 billion. However, because of financial difficulties, the potato plant was not able—and continues not to be able—to participate in the project.

The gmina and the brewery then agreed to participate jointly in the project, dividing their responsibilities 54% to 46%, respectively. This division of responsibility applies to each entity's portion of the cash payments, collateral for the debt, debt service, and operating costs.

Table 4.8

FINANCING PLANS FOR THE SEWAGE TREATMENT PLANT

I. Initial Plan (000,000)		Percentage	Amount		
1	Potato Factory	68.00%	60,520		
2	Brewery	20.00%	17,800		
3	Gmina	12.00%	10,680		
	Total	100.00%	89,000		
II. Current Plan		**Percentage**	**Amount**	**Loans**	
1	Brewery	46.00%	27,600	17,940	
2	Gmina	54.00%	32,400	21,060	
	Total	100.00%	60,000	39,000	
III. Sources of Finance for Current Plan		**Total**		**Percent**	
1	National Environmental Fund - 2 Loans	24,000		43%	
2	Voivodship Grant	11,000		18%	
3	Voivodship Environment Fund - Loan	8,000		22%	
3	Gmina Grant (Together with Water Company	9,000		8%	
4	Brewery Contributions	8,000		8%	
	Total	60,000		100%	
IV. Distribution of Funds		**1991/1992**	**1993**	**1994**	**Total**
1	National Environmental Fund - 2 Loans	8,000	8,000	8,000	24,000
2	Voivodship Grant	5,000	6,000	0	11,000
3	Voivodship Environment Fund - Loan	0	0	8,000	8,000
3	Gmina Grant	4,000	1,000	4,000	9,000
4	Brewery Contributions	0	3,000	5,000	8,000
	Total	17,000	18,000	25,000	60,000

The brewery will provide approximately zł 5 billion in cash to pay its portion of the equity, and indicated that it will make its payments out of cash flow rather than borrowing. (Revenues for the brewery in 1991 were zł 134 billion and zł 155 billion in 1992.)

Project funding sources are shown in Table 4.8. The gmina has indicated that the financing has been arranged in all cases, but that the final terms have to be agreed upon for the second National Environmental Fund loan and for the voivodship loan.

The distribution of funds over the 4 years of the project is shown in Table 4.8. Payments may continue into 1995. Of the project's two phases, the first has been completed, financed principally by the gmina, the first loan from the National Environmental Fund, and the grant from the voivodship.

The loans are expected to be 5-year loans, with a 2-year grace period and a 3-year payback of the principal, at an annual interest rate of 25% of the National Bank of Poland (NBP) repurchase rate. The current NBP rate is about 30%. The town has had to pledge collateral for 100% of its portion of the loan and has pledged real estate valued at 100% of its portion of the loan. The loan from the National Environmental Fund may be forgiven for up to 50% of the principal if the gmina completes the project on time, but the "forgiveness" is not assured.[18]

The gmina is considering two options that will have an effect on the financing plan. The first is to exclude a pretreatment facility from the project. This will save about zł 5.4 billion in construction costs. The second option is that the loan from the voivodship for zł 8 billion will be given as grant rather than as a loan. Both of these options are subject to approval by the consulting engineer and the voivodship, but they have the potential to significantly reduce the cost of the project.

4.4.3 Additional Operating Costs of the Plant

Neither the gmina nor the Water Company could provide an estimate of the operating cost of the new plant, so the LEM team's engineer estimated an initial annual operating cost of zł 5 billion. LEM also has requested operating cost figures from the consulting engineer. The Water Company also must include a charge for depreciation, either for the total cost of the plant or for the Water Company's portion. Depending on the final cost of the plant and the depreciation method chosen, the depreciation charge will range from zł 500 million to 2 billion a year.

[18]Although the environmental funds seem to be authorized to forgive loans, it was not clear to the LEM team exactly what the funds' policies are on this issue. For example, if a key mission of these sources is to manage a revolving fund using repayments of previous loans, partially forgiving debts contracted by gminas would defeat this purpose; loan forgiveness might benefit this gmina, but not serve the interest of environmental protection nationally at all. Likewise, it was not clear exactly what terms would have to be met for forgiveness, or who would judge whether a borrower had met those conditions.

4.4.4 Projections of Cost

The new plant represents a significant long-range investment and burden for the gmina, even though half the costs will be paid by the brewery. The major future costs are operating expenses; debt service on the loans, including principal and interest; and depreciation charges.

The main burden will be debt service on the loans. Table 4.9 shows an analysis of the potential future debt service costs for the zł 39 billion in outstanding loans. This cost is evaluated under three inflation/interest rate scenarios. They are: (1) high inflation and high interest rates with a 30% NBP rate and a 7.50% rate for the loan, (2) a medium inflation/interest rate environment with a 20% NBP rate and 5% project rates, and (3) a low inflation/interest rate with a 10% NBP rate and a 2.5% loan rate. These scenarios are shown in Table 4.9.

The greatest burden will occur from 1995 to 1997, when the bulk of the principal on the loans has to be repaid. The largest total payment will come in 1997, when the loan payments will range from zł 12.1 billion in the low-inflation-rate scenario to zł 12.5 billion in the high-inflation-rate scenario. The largest payment for the gmina by itself is also in 1997, with 54% of the total payment representing a zł 6.7 billion payment for the gmina under a high-inflation scenario. The major problem is not the interest rates, but the size of the principal payments. These obviously would be significantly less if a portion of the loan principal amounts were to be forgiven or changed to a grant.

4.4.5 Fiscal/Financial Burden

An important consideration for the gmina and the Water Company is the total cost burden of the new main STP. This includes both the debt costs and the operating costs for the gmina and the additional depreciation costs for the Water Company. A simple way of looking at this burden is to evaluate the projected additional costs as a percentage of future revenue streams and then to evaluate the debt in relation to projected assets (see Table 4.10).

Because it has not yet been determined who ultimately will pay the gmina's share of the long-term STP costs, Table 4.10 looks at the debt and operating costs individually and the total costs for both in relation to the expected revenues for the gmina, the Water Company, and the sewer revenues of the Water Company. To simplify the analysis, only the medium interest rate/inflation alternative is evaluated. The revenues for both the gmina and the Water Company are expected to increase at about 15% annually, the same rate as for the inflation/interest rate scenario. These growth rates could be higher or lower, which would change the analysis accordingly. The gmina and Water Company are only expected to assume the gmina's portion of the operating expenses. The LEM team does not have a long-term projection of inflation for Poland.

Table 4.9

ANALYSIS OF LOANS FOR SEWAGE TREATMENT PLANT FROM NATIONAL ENVIRONMENTAL FUNDS AND VOIVOIDSHIP ENVIRONMENTAL FUND

Assumptions:

Amounts (000,000):			Allocations:	
National Environmental Fund Loan 1		16,000	Gmina	54.00%
National Environmental Fund Loan 2		10,000	Brewery	46.00%
Voivodship Environmental Fund		13,000		
	Total	39,000		100.00%

Terms:	Interest Rate Scenarios		
5 years with a 3 year grace	1. High Inflation	30.00%	7.50%
Interest rate at 25% of the Interbank Rate	2. Medium Inflation	20.00%	5.00%
	3. Low Inflation	10.00%	2.50%

Loan Payment Analysis (000,000)

	Year	1992	1993	1994	1995	1996	1997	1998	Total
Beg. Balance		0	8,000	27,000	36,000	29,000	19,000	7,000	
Disbursements	NEFL1	8,000	8,000						16,000
	VVEFL		6,000	7,000					13,000
	NEFL2		5,000	5,000					10,000
Payments	NEFL1			(3,000)	(4,000)	(4,000)	(5,000)		(16,000)
	VVEFL				(2,000)	(3,000)	(4,000)	(4,000)	(13,000)
	NEFL2				(1,000)	(3,000)	(3,000)	(3,000)	(10,000)
Ending Balance		8,000	27,000	36,000	29,000	19,000	7,000	0	0
Interest Payment									
1. High Inflation		600	2,025	2,700	2,175	1,425	525	0	
2. Medium Inflation		400	1,350	1,800	1,450	950	350	0	
3. Low Inflation		200	675	900	725	475	175	0	
Principal Payments		0	0	3,000	7,000	10,000	12,000	7,000	39,000
Total Payments									
1. High Inflation		600	2,025	5,700	9,175	11,425	12,525	7,000	48,450
2. Medium Inflation		400	1,350	4,800	8,450	10,950	12,350	7,000	45,300
3. Low Inflation		200	675	3,900	7,725	10,475	12,175	7,000	42,150
Gmina Portion of Payments									
1. High Inflation		324	1,094	3,078	4,955	6,170	6,764	3,780	26,163
2. Medium Inflation		216	729	2,592	4,563	5,913	6,669	3,780	24,462
3. Low Inflation		108	365	2,106	4,172	5,657	6,575	3,780	22,761

Table 4.10

ANALYSIS OF SEWAGE TREATMENT PLANT COSTS FOR GMINA AND WATER COMPANY

Assumptions:								
Economic Scenario:	Medium Inflation			Gmina Revenues Increase			15%	
Interest Rates:	Medium Inflation			Water Company Revenues Increase			15%	
O&M Costs:								
Starting Amount (000,000)	5,000							
Annual Increases	15%							
Gmina Portion of O&M Costs		2,700						
		54.00%						
Gmina Portion of Payments	1992	1993	1994	1995	1996	1997	1998	
1. High Inflation	324	1,094	3,078	4,955	6,170	6,764	3,780	26,163
2. Medium Inflation (MI)	216	729	2,592	4,563	5,913	6,669	3,780	24,462
3. Low Inflation	108	365	2,106	4,172	5,657	6,575	3,780	22,761
Gmina Total Costs								
Gmina Loan Payments - MI	216	729	2,592	4,563	5,913	6,669	3,780	
Gmina O&M Costs	0		1,350	2,700	3,105	3,571	4,106	
Total	**216**	**729**	**3,942**	**7,263**	**9,018**	**10,240**	**7,886**	
Gmina								
Gmina Total Revenues		73,000	83,950	96,543	111,024	127,677	146,829	
Total Costs as Percent of Revenues		1.00%	4.70%	7.52%	8.12%	8.02%	5.37%	
Operating Expenses as Percent of Revenues		0.00%	1.61%	2.80%	2.80%	2.80%	2.80%	
Loan Payments as Percent of Revenues		1.00%	3.09%	4.73%	5.33%	5.22%	2.57%	

Water Company Revenues	1992	1993	1994	1995	1996	1997	1998
Water Company Total Revenues		9,200	10,580	12,167	13,992	16,091	18,504
Total Costs as Percent of Revenues		7.92%	37.26%	59.69%	64.45%	63.64%	42.62%
Operating Expenses as Percent of Revenues		0.00%	12.76%	22.19%	22.19%	22.19%	22.19%
Loan Payments as Percent of Revenues		7.92%	24.50%	37.50%	42.26%	41.45%	20.43%
Water Company Sewer Revenues							
Water Company Sewer Total Revenues		4,800	5,520	6,348	7,300	8,395	9,655
Total Costs as Percent of Revenues		15.19%	71.41%	114.41%	123.53%	121.97%	81.69%
Operating Expenses as Percent of Revenues		0.00%	24.46%	42.53%	42.53%	42.53%	42.53%
Loan Payments as Percent of Revenues		15.19%	46.96%	71.88%	81.00%	79.44%	39.15%
Highest Total Payment as Percent of Current Budget		Highest Payment		10,240			
		Current Budget		73,000			
		Payment/Budget		14.03%			

46

If the gmina were to pay both the debt costs and the operating costs, the largest expected total cost, operating expenses plus debt service, would occur in 1997, at over zł 10 billion. This number represents about 8% of total expected gmina revenues, and 14% of current revenues. The debt service is expected to represent about 5% of revenues. Eight percent is a significant amount of the gmina's resources to be dedicated to a single investment. A figure of 5 to 10% for debt service is the general rule used by rating agencies for cities and towns in the US, where anything more than 10% is considered very heavy debt, and 20% represents serious overindebtedness.

Since the town has heavy investment needs, 8% is a reasonable amount to assume, especially given that after 1988 the burden would decrease quickly as the plant was paid off. Nevertheless, this amount of debt could also limit the gmina's ability to assume additional debt for any other future projects for which payments might have to be made simultaneously with these loan payments.

If the Water Company were to assume the full costs of the plant, including operating costs, depreciation, and debt service, the burden on the Water Company would be immense. A significant increase in rates would have to occur to sustain these responsibilities, since total cost requirements in 1997 would be over 65% of all the company's projected revenues. Rates would have to rise about 15% per year until 1997 and then would have to increase by another 65%, resulting in household sewer and water rates of over zł 10,000 m^3. If depreciation were added, the rates would need to rise even more significantly. If only sewer revenues were evaluated, the numbers also would be much higher. If only operating costs were evaluated, the cost would have to rise by about 124% in 1997.

The debt burden is harder to determine for the gmina because the team did not have a balance sheet or a listing of the gmina's assets. If the gmina could pledge collateral for 100% of its portion of the debt, however, then it must have the assets necessary to cover the debt. When the new plant is transferred to the Water Company, it will represent a significant addition to the company's asset base, increasing assets from about zł 48 billion to zł 110 billion. If the total debt burden of zł 39 billion—or even the gmina's portion of zł 22 billion—were transferred, the debt would represent about 36% or 20% of total assets. This is not a high debt burden in comparison to assets (the US average for water and sewer companies is 30%). The real question is not the size of the debt, but the burden of debt and operating costs as compared to cash flows and rates.

4.5 Affordability of Sewer and Water Rates

Affordability measures people's ability to bear fees for water and service charges. There are two ways to measure "ability to pay." First is to analyze water and sewer rates on a per household basis, which is the usual method; second is to evaluate the burden based on per capita information. The team does not have information on household income in Namysłów, the voivod, or the country; thus, the first option cannot be completed.

Table 4.11 is an affordability study/calculation based on per capita income in Poland. Because the data are very general, as is the estimate, this section is done as much as an exercise to show how it should be done as to describe the real situation on affordability of water rates in the gmina. Because of the lack of data on per capita income in Namysłów and the voivod, the Namysłów data have been extrapolated from very general national estimates. The basic assumptions are that per capita income in Poland was zł 4 million per month for 1993; income in Namysłów is about 65% of the national average; the rate for average daily consumption of water, as provided by the LEM engineer, is 0.158 m^3 per person; and the household rates for water and sewer are zł 3000/m^3 for both. We do not have any data for calculating business rates, so these must be looked at individually.

As shown in Table 4.11, based on these very tentative and general assumptions, the total burden for water and sewer rates as a portion of per capita income is 1%. The World Bank indicates that an acceptable level is up to 5% of household income in some cases. In the US, water rates average about 0.5% of per capita income. A more precise calculation can be done once better data are available.

4.6 Gmina-Proposed Environmental Projects

As indicated in the technical section, LEM has designated three priority environmental projects with financing consequences. The first is the nearly completed STP; the second, the waste issue at the potato factory; and the third, management of wastewater in the rural villages and small industries. (The sample costs shown in Table 4.12 cover Głuszyna, the first large village scheduled to receive an STP, and the gmina's distilleries.) The refinancing of the current national environmental loan is another potential alternative.

The general costs of the projects listed below were estimated by the team's engineer and are for illustration only.

Table 4.11

AFFORDABILITY STUDY: PER CAPITA CALCULATIONS

Monthly Salary Per Capita in Poland	4,000,000
Namysłów as 65% of Polish Income	65.00%
Monthly Income in Namysłów	2,600,000
	× 12
Yearly Income in Namysłów	31,200,000
Yearly Water Consumption (m^3)	
(0.158 m^3/day × 365)	55
Rates (zł/m^3):	
Water	3,000
Sewer	3,000
Annual Charge:	
Water zł/year	165,000
Sewer zł/year	165,000
Total Yearly Payments	330,000
Yearly Payments as Percent of Annual Income	1.06%

Table 4.12

ESTIMATED PROJECT COSTS

Project	Amount (zł 000,000)	Examples (zł 000,000)	Amount ($US)
Option 1a	29,000		1,450,000
Option 1b	15,000		750,000
Option 2	50,000		2,500,000
Option 3	30,000		1,500,000
	15,000 to 50,000	40,000	2,000,000

Project	Amount (zł 000,000)	Examples (zł 000,000)	Amount ($US)
Głuszyna	7,000	7,000	350,000
Distilleries	3,000	3,000	150,000
Refinancing	22,000	22,000	1,100,000
		72,600	3,600,000

An estimated total cost of all the projects is zł 72 billion, or US $3.6 million. Excluding the refinancing, the total costs of the other three projects is zł 50 billion or US $2.5 million. The main cost is related to waste disposal at the potato plant.

4.7 Operating Costs

In addition to capital costs, each project has operating costs. The operating costs of the potato factory wastewater treatment plant, estimated by the LEM engineer, are zł 1 billion; the LEM team did not estimate operating costs for the other projects named in Table 4.12.

4.8 Financing Sources

Financing for potential environmental projects such as those being discussed and constructed in Namysłów will be from either *internal* or *external* sources. Namysłów has already demonstrated a capacity to raise funds from several of these sources.

- Internal: cash flows from the Water Company, contributions from businesses, hookup charges, assessment charges, gmina borrowing, Polish bank borrowing, sale of bonds in the local bond market, loans from voivodship and national environmental funds, and loans or grants from a new entity for government funds.

- External: grants or loans from bilateral development agencies, such as USAID, multilateral entities such as the World Bank, foundations, and nonprofit organizations.

In 1992 and 1991, a GOP study entitled "The Possibilities of Financing Environmental Projects" indicated that 95% of all financing for environmental projects in Poland came from internal sources. While external sources may increase somewhat in future years, local sources are likely to remain the most commonly used. The main sources of finance listed for 1991 and 1992 were businesses, 30%; National Environmental Fund, 25%; local government, 20%; central government, 5%; and external, 5%. However, 15% is not accounted for in the study; it is not known whether the missing figure compromises the validity of the remaining values given.

4.8.1 Internal Sources of Finance

1. *The Water Company.* There are many projects that the Water Company can fund on its own from internally generated funds. Its free cash flow in 1992-93 was almost zł 4 billion.

2. *Local charges.* A common form of payment for sewer and water systems is to assess households for improvements. The theory is that the benefit accrues to the homeowner because having utilities increases the value of the property. This source should be used for small projects.

3. *Private businesses.* Companies that generate waste should pay. The town has done a good job of getting companies to participate in financing projects.

4. *Polish banks.* The cost of funds in Poland is now very high and maturities are very short. Interest rates are about 30% for 1- to 3-year maturities. The government is hoping to extend the market by issuing longer-term (5-year) government bonds, and this may help. Nevertheless, if inflation is high, interest rates will also be high and maturities will remain short. The ability of Polish banks to make long-term loans will depend on macroeconomic policies.

5. *Voivodship and national environmental funds.* Both the national government and the voivodship have created environmental funds to finance projects. This money accrues largely from fees and penalties on polluters. The funds provide both loans and grants to gminas, at low interest rates and at maturities up to 5 years. The exact terms depend on the financial condition of the gmina. The goal is to make the funds self-perpetuating as loans are repaid. The national fund is well capitalized, but the major question is the amount of penalties that will flow to the voivodship fund and how much money it will have to lend.

6. *Municipal bond market.* An alternative to bank financing is directly issuing bonds and raising funds in the capital markets. With bond issues, funds are raised directly either from individuals or from financial institutions. At this time, legal restrictions limit the market. Further, the capital markets in Poland are not well developed. As the market develops, this will be a better source of funds whose cost and maturity will be comparable to borrowing directly from a bank. Cost and maturity will depend on the monetary and fiscal policies of the country.

7. *Municipal Development Bank.* There are proposals to create a municipal development bank. The bank, whose purpose would be to make loans for infrastructure projects in Poland, would remain as a financial institution as long as commercial banks were unwilling to make long-term loans for infrastructure projects. The proposal initially is to have the bank make loans at lower interest rates and for longer maturities than are available in the financial

markets, and to fund it with grants from the national government and multilateral and bilateral organizations.

8. *EcoBank SA.* The EcoBank was created as a private entity to make loans for environmental projects. Some loans are to be given on a concessional rate basis, similar to the loans of the environmental funds. The Bank had allocated about zł 130 billion in loans as of July 1993, and hopes to increase its capital to zł 330 billion in the coming year. The EcoBank lends for (a) "ecological" projects, (b) rural fuel supplies, (c) energy-saving modifications, and (d) development of small businesses. The bank has opened 15 branches around the country.

9. *Polish Development Bank.* This bank provides capital loans, in both złotys and foreign currencies, for large industrial projects, especially for environmental projects.

10. *Ekofund.* The Ekofund was created from rescheduled loans of the Polish government, to be allocated as grants for specific environmental projects. In the first few months of its existence, the Ekofund accepted 14 projects at a value of zł 120 billion, or zł 10 billion per project.

4.8.2 External Sources of Finance

Bilateral Agencies

Every developed country has agencies that make loans and grants for infrastructure projects in certain designated countries. Some examples are the Overseas Economic Cooperation Fund of Japan, the Kreditanstalt fur Wiederaufbau of Germany, and aid agencies of the Nordic countries. For almost all these countries and entities, environmental projects are a major priority. These entities provide grants as well as loans that usually are made at very concessional terms. The size of the projects can be as small as US $100,000 or up to tens of millions of dollars. These funds are generally provided in the currency of the loaner but can be available in local currencies.

Multilateral Agencies

<u>World Bank, European Bank for Reconstruction and Development (EBRD), European Investment Bank (EIB): Public Projects</u>. The World Bank, the EBRD, and the EIB make loans for infrastructure projects and are interested in environmental projects. The terms of the loans are at market or near-market interest rates but with extended maturities. In most cases, these funds are loaned directly to governments, which on-lend the funds for specific projects. They usually require a government guarantee. However, in most cases, these loans are made for large projects and Namysłów would only be eligible if loans were disbursed for a large number of projects as a package. Further, the EBRD has great difficulty in setting up these loans in Poland because the Polish government will not co-sign.

The World Bank, in conjunction with the United Nations, operates the Global Environmental Facility. The Fund makes loans and grants for environmental projects. Poland has not yet used any of the funds.

International Finance Corporation, EBRD: Private. This institution provides loans and equity investments to private companies. It is interested in environmental projects, but usually considers only large ones.

Foundations and Nonprofit Entities

Many nongovernmental organizations (NGOs) make loans and grants for environmental projects. These are usually for amounts consistent with the needs of the Namysłów projects. The German-Marshall Fund, for example, already has provided assistance. The difficulty is in locating the various organizations and meeting their requirements for funds.

Pooled Financing

One alternative is to combine Namysłów's needs with those of other gminas and to present the funding requirements to international organizations as a package. The advantage of this approach is that there would be a larger amount for the lender to evaluate. The disadvantage is the different credit standing and the different financial circumstances for each project in different gminas.

4.8.3 Cost Comparison

Table 4.13 is a comparison of the costs of financing through the various alternatives. For each funding source, a hypothetical borrowing amount of zł 10 billion is assumed. The sources of finance are analyzed on both an absolute and a present value basis. Because of the currency risk with loans denominated in a non-Polish currency, these two alternatives are evaluated both with no change in the exchange rate and with a constant 15% devaluation in the złoty, an expected inflation rate. This comparison is done merely to show the costs and risks of different borrowing scenarios.

Table 4.13

PORÓWNANIE KOSZTÓW RÓŻNYCH ŹRÓDEŁ FINANSOWANIA[a]

Ranking

1 Dotacja	0	5 Bank Światowy - nie ma dewaluacji	10.000.000.000
2 Kredyt na warunkach preferencyjnych - nie ma dewaluacji	6.072.741.037	6 Obecnie kredyt z banku handlowego	15.669.613.372
3 Państwowy i Wojewódzki Fundusz Ochrony Środowiska	9.800.364.498	7 Kredyt na warunkach preferencyjnych - dewaluacja	44.884.932.429
4 Kredyt z banku komercyjnego - niska inflacja	10.000.000.000	8 Kredyt z Banku Światowego - dewaluacja	59.235.853.909

Rok	Dotacja	Państwowy i Wojewódzki Fundusz Ochr. Środ.	Kredyt z banku handlowego (obecnie)	Bank Światowy - nie ma dewaluacji zł	Bank Światowy - dewaluacja zł 15,00%	Kredyt na war. prefer. - nie ma dewaluacji zł	Kredyt na war. prefer. - dewaluacja zł 15,00%	Kredyt z banku handl. - niska infl.
1	0	750.000.000	3.000.000.000	800.000.000	800.000.000	400.000.000	400.000.000	800.000.000
2	0	750.000.000	3.000.000.000	800.000.000	920.000.000	400.000.000	460.000.000	800.000.000
3	0	750.000.000	13.000.000.000	800.000.000	1.058.000.000	400.000.000	529.000.000	800.000.000
4	0	750.000.000	0	800.000.000	1.216.700.000	400.000.000	608.350.000	800.000.000
5	0	10.750.000.000	0	800.000.000	1.399.205.000	400.000.000	699.602.500	800.000.000
6	0	0	0	800.000.000	1.609.085.750	400.000.000	804.542.875	800.000.000
7	0	0	0	800.000.000	1.850.448.613	400.000.000	925.224.306	800.000.000
8	0	0	0	800.000.000	2.128.015.904	400.000.000	1.064.007.952	800.000.000
9	0	0	0	800.000.000	2.447.218.290	400.000.000	1.223.609.145	800.000.000
10	0	0	0	800.000.000	2.814.301.034	400.000.000	1.407.150.517	10.800.000.000
11	0	0	0	800.000.000	3.236.446.189	400.000.000	1.618.223.094	0
12	0	0	0	800.000.000	3.721.913.117	400.000.000	1.860.956.558	0
13	0	0	0	800.000.000	4.280.200.084	400.000.000	2.140.100.042	0
14	0	0	0	800.000.000	4.922.230.097	400.000.000	2.461.115.049	0
15	0	0	0	800.000.000	5.660.564.612	400.000.000	2.830.282.306	0
16	0	0	0	800.000.000	6.509.649.303	400.000.000	3.254.824.652	0
17	0	0	0	800.000.000	7.486.096.699	400.000.000	3.743.048.349	0
18	0	0	0	800.000.000	8.609.011.204	400.000.000	4.304.505.602	0
19	0	0	0	800.000.000	9.900.362.884	400.000.000	4.950.181.442	0
20	0	0	0	10.800.000.000	153.703.133.777	10.400.000.000	148.010.425.119	0
Razem	**0**	**13.750.000.000**	**19.000.000.000**	**26.000.000.000**	**224.272.582.556**	**18.000.000.000**	**183.295.149.508**	**18.000.000.000**
Wartość bieżąca netto	0	9.800.364.498	15.669.613.372	10.000.000.000	59.235.853.909	6.072.741.037	44.884.932.429	10.000.000.000

[a]Kwota kredytu: 10 mld. zł. 500.000 USD. Stopa dyskontowa: 8,00%.

102

Based on Table 4.13, the order from least to most expensive would be:

- grant
- concessional-rate financing at 4% interest, no exchange rate risk
- environmental fund loan at 7.5%
- commercial bank loan at 8%, low inflation
- World Bank loan at 8%, no exchange rate risk
- commercial bank loan at 30%
- concession-rate financing at 4%, constant devaluation of 15%
- bilateral loan, non-Polish currency, constant devaluation in currency.

This pattern illustrates that the lower the interest rate and the longer the maturity, the lower the cost. However, also important is the denomination of the currency and the high cost of external funds with constant devaluation.

4.9 Financial Assessment

4.9.1 Refinancing

Given the very large principal payments Namysłów will need to make on its loans between 1995 and 1998, the current loans are logical candidates for refinancing. The most likely refinancing vehicles are Polish banks, if Poland's financial system improves. The bulk of the principal to be paid back is in 1996 and 1997, and there is a possibility that the financial markets will have improved; if so, the existing loans could be refinanced at lower interest rates and longer maturities before that time. It is unlikely that the loan would be refinanced through external sources, although this is possible. This project would have been a prime candidate for funding by a bilateral organization if funding had not already been arranged; it is the right size and the right type of investment. If a complete feasibility study had been completed, this option could have been analyzed.

4.9.2 Potato Factory Wastewater Treatment Plant

The range of estimated costs for the ZPZ treatment plant is between zł 30 and 50 billion. A zł 15 billion alternative is also under consideration, but this would involve a different financing plan for a much smaller amount. To simplify analysis of the impact of the financing and the potential costs, a middle figure of zł 40 billion is used here. This can serve as a representative example of the financing costs and the potential financing sources.

The most logical entity to finance the pretreatment facility is the potato factory itself. However, the factory could not participate in the plant that is just being completed, and its finances are still limited. Yet any other funding source will presume that the gmina itself would want some participation from

the factory. One possibility is for a new owner—if the factory is privatized—to participate in the financing of the facility.

The gmina must decide whether it is willing to participate in the financing. From a policy viewpoint, it could be viewed as contributing to a newly restructured or newly owned factory. However, the gmina would be making a large and serious commitment by offering to finance the entire cost of the facility, particularly given the substantial debt service costs of the newly constructed main STP and the possibility that the factory may not survive economically. The gmina could participate financially in several other ways to help a new owner, such as guaranteeing or co-signing any loans. The extent of the gmina's participation obviously is both a political and an economic decision.

The most logical sources of financing are a combination of the factory, the gmina, local environmental funds, and external sources. For example, the gmina and the factory could split the cost 50/50 (see Table 4.14). Further, for this example, the debt-to-equity ratio is proposed at 20% equity and 80% debt (Table 4.14). The 80% debt would be divided 50/50 between internal sources such as the national and voivodship environmental funds, and external ones such as the bilateral organizations or (for a pooled loan) a multilateral bank. The financing structure is shown in Table 4.14. The gmina and the factory would each have to contribute zł 4 billion in cash.

The terms for the local loan would be a 5-year maturity and a reduced interest rate; the terms for the external loans would be a 15-year maturity with 8% (or market rate) interest. One major assumption under this scenario that reduces the cost of the debt is that the external loan would be in złotys, not a non-Polish currency. Foreign loans are likely to be in foreign currencies and be subject to currency risk.

The total debt service payments are shown in Table 4.14. The largest payments are in years 1997 to 1999 and then extend to the year 2009. The principal payment schedule and the total loan payment shows the combination of the two loans. The gmina and the factory would be required to split the costs. The highest combined payment would be zł 6.1 billion in 1997, and the payments after 1999 would average about zł 1.7 billion.

As with the new main treatment plant, the cost of facilities would be the debt payments plus any new operating costs (Table 4.15). The estimated operating costs would be zł 1 billion in the first year of operation. The largest combined cost would be zł 8.7 billion in 1997, with the gmina and potato factory each responsible for half the payment. This payment would represent about 3% of projected gmina revenues in that year and about 6% of projected potato factory revenues, assuming the revenues of both grow at 15% a year from today (November 1993).

Table 4.14

ANALYSIS OF LOANS FOR POTATO FACTORY[a]

Financing plan:	Percentage	Amount		
Cash contributions				
Potato factory	10.00	4,000	ZPZ portion:	50.00%
Gmina	10.00	4,000	Gmina portion:	50.00%
Polish environmental loans	40.00	16,000	Total	100.00%
External loans	40.00	16,000		
Total	100.00	40,000		

Loan payment analysis (000,000)	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
External Loans																	
Beginning Balance	0	16,000	16,000	16,000	16,000	16,000	16,000	14,400	12,800	11,200	9,600	8,000	6,400	4,800	3,200	1,600	
Disbursement	16,000																16,000
Payment							(1,600)	(1,600)	(1,600)	(1,600)	(1,600)	(1,600)	(1,600)	(1,600)	(1,600)	(1,600)	(16,000)
Balance	16,000	16,000	16,000	16,000	16,000	16,000	14,400	12,800	11,200	9,600	8,000	6,400	4,800	3,200	1,600	0	
Interest	1,280	1,280	1,280	1,280	1,280	1,280	1,152	1,024	896	768	640	512	384	256	128	0	13,440
Total Payment	1,280	1,280	1,280	1,280	1,280	1,280	2,752	2,624	2,496	2,368	2,240	2,112	1,984	1,856	1,728	1,600	29,440
Environmental Loans																	
Beginning Balance	0	16,000	16,000	16,000	10,667	5,333	0	0	0	0	0	0	0	0	0	0	
Disbursement	16,000																16,000
Payment				(5,333)	(5,333)	(5,333)											(16,000)
Balance	16,000	16,000	16,000	10,667	5,333	0	0	0	0	0	0	0	0	0	0	0	
Interest	800	800	800	533	267	0	0	0	0	0	0	0	0	0	0	0	3,200
Total Payment	800	800	800	5,867	5,600	5,333	0	0	0	0	0	0	0	0	0	0	19,200
Total Payments, 2 Loans	2,080	2,080	2,080	7,147	6,880	6,613	2,752	2,624	2,496	2,368	2,240	2,112	1,984	1,856	1,728	1,600	48,640
Potato Factory Portion	1,040	1,040	1,040	3,573	3,440	3,307	1,376	1,312	1,248	1,184	1,120	1,056	992	928	864	800	24,320
Gmina Portion	1,040	1,040	1,040	3,573	3,440	3,307	1,376	1,312	1,248	1,184	1,120	1,056	992	928	864	800	24,320

[a]Loan terms:

Polish environmental loans - 6 years with a 3-year grace period; interest rate at 25% of NBP repurchase rate
External loans - 15 years, 5-year grace period; interest rate 8%

Assumptions:

Inflation - 15.00%
Interbank rate - 20.00%
Environmental loan rate - 5.00%
External loans - 8.00%

Table 4.15

ANALYSIS OF AFFORDABILITY OF POTATO FACTORY LOANS[a]

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Combined (Gmina + Potato Factory)																
Loan Payments	2,080	2,080	2,080	7,147	6,880	6,613	2,752	2,624	2,496	2,368	2,240	2,112	1,984	1,856	1,728	1,600
Operating Expenses	1,000	1,150	1,323	1,521	1,749	2,011	2,313	2,660	3,059	3,518	4,046	4,652	5,350	6,153	7,076	8,137
Total Costs	3,080	3,230	3,403	8,668	8,629	8,625	5,065	5,284	5,555	5,886	6,286	6,764	7,334	8,009	8,804	9,737
Gmina 50%																
Loan Payments	1,040	1,040	1,040	3,573	3,440	3,307	1,376	1,312	1,248	1,184	1,120	1,056	992	928	864	800
Operating Expenses	500	575	661	760	875	1,006	1,157	1,330	1,530	1,759	2,023	2,326	2,675	3,076	3,538	4,069
Total Costs	1,540	1,615	1,701	4,334	4,315	4,312	2,533	2,642	2,778	2,943	3,143	3,382	3,667	4,004	4,402	4,869
Projected Revenues	85,000	97,750	112,413	129,274	148,666	170,965	196,610	226,102	260,017	299,019	343,872	395,453	454,771	522,987	601,435	691,650
Loan Payments as Percent of Revenues	1.22%	1.06%	0.93%	2.76%	2.31%	1.93%	0.70%	0.58%	0.48%	0.40%	0.33%	0.27%	0.22%	0.18%	0.14%	0.12%
Operating Costs as Percent of Revenues	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%
Total Costs as Percent of Revenues	1.81%	1.65%	1.51%	3.35%	2.90%	2.52%	1.29%	1.17%	1.07%	0.98%	0.91%	0.86%	0.81%	0.77%	0.73%	0.70%
Potato Factory 50%																
Loan Payments	1,040	1,040	1,040	3,573	3,440	3,307	1,376	1,312	1,248	1,184	1,120	1,056	992	928	864	800
Operating Expenses	500	575	661	760	875	1,006	1,157	1,330	1,530	1,759	2,023	2,326	2,675	3,076	3,538	4,069
Total Costs	1,540	1,615	1,701	4,334	4,315	4,312	2,533	2,642	2,778	2,943	3,143	3,382	3,667	4,004	4,402	4,869

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Projected Revenues	42,000	48,300	55,545	63,877	73,458	84,477	97,149	111,721	128,479	147,751	169,913	195,400	224,711	258,417	297,180	341,757
Loan Payments as Percent of Revenues	2.48%	2.15%	1.87%	5.59%	4.68%	3.91%	1.42%	1.17%	0.97%	0.80%	0.66%	0.54%	0.44%	0.36%	0.29%	0.23%
Operating Costs as Percent of Revenues	1.19%	1.19%	1.19%	1.19%	1.19%	1.19%	1.19%	1.19%	1.19%	1.19%	1.19%	1.19%	1.19%	1.19%	1.19%	1.19%
Total Costs as Percent of Revenues	3.67%	3.34%	3.06%	6.78%	5.87%	5.10%	2.61%	2.36%	2.16%	1.99%	1.85%	1.73%	1.63%	1.55%	1.48%	1.42%

*Assumptions:
Growth in Gmina Revenues - 15.00%
Growth in Potato Factory Revenues - 15.00%

For the gmina, these payments would be in addition to the payments for the new treatment facility. If the payments for both plants were added together, they would represent almost 10% of gmina revenues in the period 1996 to 1997. One option would be for the gmina to delay any financing of the potato factory pretreatment plant until the other payments are reduced or completed.

The question for the potato factory is whether it would be able financially to assume its share of the pretreatment facility costs. Clearly, it would have to improve its financial performance and be able to raise new capital. The largest annual payment for the factory would be zł 4.3 billion in 1997.

4.9.3 Wastewater Treatment for Villages

The estimated cost for the first village sewer system to be arranged, in Głuszyna, is zł 7 billion. The gmina has proposed three sources of financing for the system: (1) a German foundation, 30%, or zł 2.1 billion; (2) The gmina or the waterworks, 20%, or zł 1.4 billion; and (3) the voivodship, 50%, as a loan for which half would be forgiven and converted to a grant. Therefore, the gmina's net cost of the project would be only 25% of zł 7 billion, or zł 1.75 billion, which would be the unforgiven portion of the voivodship loan. The annual interest would be about zł 175 million and the maximum debt service would be about zł 700 billion. This would be a manageable amount of debt for the gmina and the Water Company. There is, however, a strong financial argument that the residents of Głuszyna, who would receive the greatest benefit for the expenditure, should pay at least some minimum amount for the system.

The other village projects were not far enough along in November 1993 to make a useful estimate of costs or financing options. The gmina, however—as does LEM—feels that household septage should be collected without assessment of direct user charges. Instead, costs should be recouped through some surcharge on the price of water.

4.9.4 Wastewater Pretreatment for Rural Industries

This investment would best be funded by the industries themselves, namely the distilleries, which have indicated that their business is doing well. If the gmina decides to fund the project, the funds could come from gmina revenues. A possible outside source might be a foundation or nonprofit organization if the environmental problem is viewed as large enough.

4.10 Summary of Financial Recommendations

4.10.1 Economic Conditions

In order to raise debt funds and to attract capital, the gmina will have to be able to describe its past, current, and future economic condition in great detail. The gmina has made an excellent start by

publishing, in both Polish and English, an economic description of the gmina. The gmina is preparing an updated version with more information, although the information they already have provides a solid base. The LEM team's suggestion of additional information that banks and investors might want to know and that could be included in future versions are: (1) more information on past data that would indicate trends such as historical information on changes in population and employment; (2) additional information on the economics of the gmina such as per capita income, changes in the price of key commodities, and the number of building permits issued; and (3) more comparisons to the country in general or conditions in the voivodship in general, such as how unemployment in the gmina compares to unemployment in the nation or the voivodship.

4.10.2 Gmina Budget

1. The gmina's budget continues to be too heavily controlled by the national government through fee/rate setting, shared taxes, and national grants. The gmina will have to expand its ability to raise local taxes, particularly the local real estate tax. Adopting a long-term goal for an *ad valorem* property tax might generate more revenue and be more equitable than is now the case.

2. In order to borrow in the financial sector or from overseas entities, the gmina must generate audited financial statements, including fund statements and balance sheets. As described in the Chapter 3 recommendations, the gmina may soon need to submit to an audit based on government accounting standards—once standards are set. A complete financial statement also would allow the gmina to better manage its finances and operations.

3. The gmina does not set aside funds as reserves or for investments. As part of the long-term financial strategy of the gmina, it should set up reserve accounts and plan how to invest its funds.

4.10.3 New Sewage Treatment Plant

1. At a later date, if the financial climate improves or cheaper outside financing is arranged, the gmina could refinance the existing loans and either decrease interest payments or extend maturities, thus decreasing the size of future payments.

2. The gmina and Water Company should have completed a financial and economic feasibility study prior to construction to determine debt costs, operating costs, and affordability. The gmina could not provide an estimate of the plant's operating costs or of the burden to the Water Company or the gmina. Similarly, there was no analysis of the combined effect of the plant's operating cost and debt service, either on tax rates or on water/sewer rates. The gmina has indicated that it will be establishing the capability to complete such feasibility

studies. LEM supports this plan; until that time, the project could supply technical assistance to complete financial analysis of future projects.

4.10.4 Namysłów Water Company

The main financial responsibility for the Water Company will be to maintain the progress and momentum that it has established. The company should request a complete audit, maintain the momentum to rationalize rates, continue investing, and not take on financial burdens beyond its capability carry them.

4.10.5 New Investments

1. The gmina should not invest in the ZPZ treatment facility except in concert with a revitalization/restructuring of ZPZ itself. The gmina should undertake an economic and financial feasibility study before initiating any involvement with the treatment plant.

2. The gmina should determine the preferred engineering solutions for meeting the sewerage needs of the villages, and then search for methods of financing.

5 RECOMMENDATIONS FOR ADDITIONAL TECHNICAL ASSISTANCE AND TRAINING

5.1 Recommendations for Additional LEM Technical Assistance

5.1.1 Overall Recommendations - Whole Gmina

Technical assistance is required to help gminas develop and manage comprehensive feasibility studies for wastewater treatment projects from the very beginning of the project development process. Such studies would:

- define existing conditions and needs based on rigorous analysis of current and anticipated flows and treatment loads, as well as naming the most suitable methods of treament for rural wastewater, given these conditions;
- adapt methods of cost-effectiveness analysis (value engineering);
- effectively employ the process of selecting solutions by means of value analysis, consulting experts and defining a method for managing the subsequent stages of investment; and
- evaluate realistic financing alternatives and affordability for each option, including capital and operating costs, project pro formas, funding analysis, and debt burden and ratio analysis.

In Namysłów's case, a feasibility study still could be used to assess or confirm the sewerage needs of the gmina's villages and small industries. LEM could review the scope of the feasibility study, critique the method by which the study would be carried out, and assist the gmina in reviewing the final recommendations. LEM also could teach methods of cost-effectiveness analysis that take into account both economic and noneconomic issues (such as aesthetics, employment, health).

Advise on ZPZ Wastewater Treatment Issues

The LEM team strongly recommends close ongoing consultation between gmina officials and ZPZ management/owners to resolve the ZPZ waste problem. LEM's contribution could be to assist with reassessing and recosting the three options presented in Section 2.3.4, particularly the least-cost combined treatment proposal; and completing a thorough hydrogeological study, including estimating

the fraction of wastewater that can be handled in the present land parcel without degrading the southern well field.

Support Treatment Plants for Rural Distilleries

LEM recommends that Namysłów look again at the implementation and development of treatment plants for the rural distilleries, and how they fit the environmental and financial picture in the gmina. There will be arguments for and against these projects, so the benefits to be gained should be clearly demonstrated to the industries involved. As part of this effort, LEM also could assist in assessing O&M costs for various treatment configurations.

Support Village Systems

LEM could support several aspects of the planned improvements for wastewater treatment in Namysłów's villages. For example, although the voivodship Irrigation Design Office in Opole prepared a facility siting plan for the villages in 1988 at the gmina's request, there still needs to be an updated, comprehensive, and coordinated 5-year implementation plan that specifies what is to be done, who is to do it, what sequence of implementation is to be followed, and who pays. This plan would require coordination among a number of agencies and would need to be revised annually, clarifying agency roles as it developed. On a smaller scale, LEM could help ensure that the plan incorporated information from LEM-assisted feasibility studies used to identify the best treatment options and to estimate likely capital and O&M costs for treatment systems under consideration.

Expand Land-Use Plan

The LEM team was able to collect only cursory information about revisions to the gmina's 5-year land-use plan. The team understands that Polish law requires revisions to municipal land-use plans at 5-year intervals. During the field visit in November, Namysłów was in the process of performing its required update with the technical support of a local land-use planning firm. LEM recommends that the plan incorporate septic system design standards, protection measures for aquifers and wellheads, and linkages between the land-use plan and the gmina's water, wastewater, and other environmental needs. LEM could provide technical assistance to help the gmina take full advantage of its land-use planning and regulatory powers as a tool to support its environmental agenda.

Advise on Household Septage Systems

At present the gmina has no design or performance standards for individual or public septic/sewerage systems. For example, homeowners' holding tanks should be inspected for leaks, cracks, and illegal connections, since unmonitored connections to local watercourses could completely negate the efforts

of authorized treatment plants in the same area that are trying to achieve secondary and tertiary effluent quality. LEM could supply examples of such standards in use elsewhere that might be adaptable to Namysłów's situation, as well as providing support in obtaining the legal authority to establish and enforce the standards if necessary. In addition, as long as septage continues to be transported from the villages to the infiltration lagoons (and, in the future, to the STP), standards for septage hauling, disposal, and treatment should also be taken into account.

Investigate Point and Nonpoint Source Pollution

Regional officials and environmentalists alike have expressed concern that uncoordinated and under- or unregulated activities in the Widawa and upper Odra river basins have the potential to negate the positive impacts of Namysłów's new STP and facilities like it. These concerns focus on agricultural runoff, erosion, poor rural sanitation, poorly managed animal wastes, and industrial discharges. The Namysłów team reaffirms the value of additional LEM technical assistance on nonpoint source pollution already in progress; this effort should identify the major activities in the Widawa basin that pose such environmental risks, and work toward a regional solution by involving governments, nongovernmental organizations, and regulatory agencies.

5.1.2 Assistance on Main STP

Develop an Operating Manual and Troubleshooting Guide

As of November 1993, no instruction/operating manual for the Namysłów main STP had yet been prepared. LEM could supply ongoing support to extract the best possible instruction manual and troubleshooting guide from the designers. It is likely that, due to the complexity of Namysłów's wastewater mix and the novelty of the processes applied, the initial operating manual will be sketchy and significant corrections will have to be made during the course of operation.

Improve Sludge Handling

LEM could advise on the type of treatability studies for sludge handling, including the choice of dosage in dewatering sludge. A component of this assistance could be consultation on how to establish regular bidding among several suppliers, to minimize the cost to the gmina.

Further, if a portable dewatering device is approved as LEM recommends, and the gmina opts to use the equipment in more than one location (such as selling the dewatering service to other gminas), the operators will need a method and field instruction manual for determining on-site the quantity of chemicals needed for sludge conditioning. LEM could help develop the most suitable procedures and instructions.

Advise on Building of Laboratory

The LEM team recommends that the NWC build a small laboratory at the site of the new STP so that the plant operator can do basic analysis to assess the plant's performance. LEM could offer technical assistance on the design of the laboratory, beyond the recommendations offered in Chapter 2.

5.2 Management

Complete O&M Cost Assessment for New STP

The NWC must secure reasonable estimates of the increased operating costs of the STP, including the increased costs of electricity, chemicals, specialized maintenance, staffing, and contingencies. LEM could act as liaison between the gmina and the designer to make sure that all the needed information is forthcoming.

Assess and Support Public Information Needs

The gmina is still formulating and experimenting with ways to inform the public about community needs and important public decisions. LEM can help the gmina develop strategies that focus on topics such as:

- the connection between potential job growth and treatment capacity, as evidenced by the ice cream factory's decision to locate in Namysłów;
- the benefits of loan and grant programs that have funded the plant, reducing the cost to citizens by 46%;
- the relationship between the value(s) the community is receiving and the rates, by calculating the costs of service on a daily basis or comparing them to the daily costs of common consumer items such as cigarettes, coffee, and beer; and
- the level of technical sophistication engineered into the plant, in which citizens can take pride. This could be demonstrated by arranging plant tours, including inviting grammar school and high school classes to come and learn about the chemical and physical principles at work in the plant.

Define Skills and Prepare Job Descriptions

LEM could support the NWC in developing position descriptions for the personnel named in the plant staffing plan, especially for the plant supervisor/manager. LEM also could help initiate a recruitment evaluation and hiring process for the plant supervisor.

Select Local On-Call Expert

The gmina already seems to support the LEM team's recommendation to have an outside expert available to the main STP on an as-needed basis, to help diagnose problems, adjust process parameters, and generally support the operation. LEM could specify the type of experience that the NWC should look for, as well as seeking out some candidates and assisting with screening.

5.3 Finance

Set Up Audit and Implement Recommended Changes

As described in detail in Chapter 3, the gmina should arrange with a private auditing firm that also has financial management systems expertise to provide an annual audit and management review of the gmina. Further, the gmina should use the results and recommendations of the first audit to strengthen its management and control systems. LEM could advise the gmina on components to request in the audit, as well as suggesting uses for the resulting information when the audit is complete.

Improve Government Accounting Procedures

In order to raise debt funds and to attract capital from banks and investors, as well as to ensure its financial credibility with the public, Namysłów needs to develop methods of presenting a complete financial picture of the gmina. To this end, LEM could assist with establishment of accounting procedures such as completion of balance sheets listing assets and liabilities, fund accounting, and construction of flow-of-funds statements.

Advise on Financial Management Issues

A broad area in which LEM could offer technical assistance is financial management, particularly capital budgeting, assessment of debt capacity, and use of information for managing the gmina.

Advise on Refinancing

Namysłów will need to make large principal payments on its loans between 1995 and 1998, which means—providing forgiveness is not obtained—that the current loans are logical candidates for refinancing. Within the limits of the project ending date, LEM could offer expertise on how refinancing works, what the most likely refinancing sources would be, and how to assess future options.

Examine Tax Laws and Exemptions

LEM could work with Namysłów and other gminas to investigate the desirability and feasibility of introducing a national parliamentary act that would exempt from the income tax (and other national taxes related to profit and turnover) public utilities operating as limited-liability companies in which 100% of stock is held by the gmina. This exemption would eliminate the major financial disadvantage of operating the water and sewer functions through a limited-liability company and, in Namysłów's case, would increase the NWC's capability to make investments in its systems.

Examine Fee Structure

Although it is still uncertain whether the gmina or the NWC will have ultimate responsibility for debt service and operating costs for the new STP, the LEM team has noted that it makes financial sense for the NWC to fund as many capital projects as possible through its user fees. This procedure would be particularly advisable if the current loans are (partially) forgiven, in which case both operating and capital costs could be worked into the fee structure. LEM could help the gmina explore various scenarios for water and sewer rates that would be affordable to users yet allow the NWC to continue making needed investments.

5.4 Training and Outreach Recommendations

The training and outreach needs identified in this section will be revised and added to during a LEM project workshop to be held near Wrocław in March 1994. The list of courses will be further refined as a result of the development of a LEM training program for Poland.

5.4.1 Training Specific to Namysłów

Contracting Activities

The competitive-bid structure for public works contracts is new to many in Poland in both the commercial and the public sectors, and this inexperience is compounded in the wastewater treatment

field by the fairly short history of Polish engineering firms with sophisticated STP experience. As a result, extensive training is needed in procurement procedures and management of projects, as well as verification and use of consultants and experts.

Nutrient Removal Processes

Designers and the gmina's operators will need training in the technology of the nutrient removal processes that are being implemented. There is little information on nutrient removal, let alone advisors with this type of operating and training experience, anywhere in Poland. LEM could offer this training in tandem with development of the instruction manual described above.

Short- and Long-Term Staff Training

In addition to the very important task of training in immediate duties for staff of the new plant, the NWC should develop a human capital investment program to make all employees as productive as possible. Training strategies for the 60% of the staff not directly involved in water and sewage treatment plant operations also should be considered. LEM could prepare more detailed staff training recommendations for the long term.

5.4.2 Training Course for Treatment Plant Operators

This course should be a two-tiered training program. The first tier should be a basic introduction into the practice of treatment plant operations and the background essentials needed to operate successfully; the second tier should build on the introductory course with a more detailed, technical application of processes and systems.

These two courses should be developed within the Polish context but with attention to practical new developments and techniques that could be applied in Poland. The courses could be given to all LEM cities at once, or in stages; the courses might also be repeated for other gmina representatives who are interested in the LEM program, particularly those who attended the Wrocław Workshop in July 1993.

Introduction to Treatment Plant Operations

This course should cover introductory information on the topic of municipal wastewater, including collection systems, piping, valves, tanks and pumps, the essentials of wastewater treatment processes and systems, sludge treatment and disposal, mechanical and chemical treatments, lagoon treatment systems, essentials of laboratory sampling and techniques, laws and regulations, and administrative record keeping. It may be necessary to include rudiments of math, chemistry, biology, hydraulics, applied electricity, health, safety, and environmental best management practice. The course should be designed to be specific to Polish practice and to the types of equipment currently being used, especially in the LEM cities.

Advanced Course in Treatment Plant Operations

This course would expand upon the basic course but with much more emphasis on the details of wastewater treatment processes and systems. Examples of topics are screening, grit removal, trickling filters, activated sludge, disinfection, lagoon systems, and similar technologies appropriate to small, rural communities; sludge treatment and removal; sampling and laboratory operations; laws and regulations; plant housekeeping; and the need for and best methods of keeping records.

5.4.3 Training in Management and Operations of Water and Wastewater Organizations

This training program should focus on improving management practices and introducing systematic administrative processes within the organization charged with the water/wastewater operations in the gmina. It should review the various options for such management (e.g., independent units, privatized companies, and joint public and private companies). The course should include a general overview of best management practices relating to operations, personnel administration, and problem solving, to name a few. Emphasis should be put on the need and methods for determining rates, budgeting for operations and maintenance, assessing capital needs, keeping effective records, writing reports, billing and collecting fees, setting rates, and understanding the close relationship between water and wastewater functions. All of this training should be designed within the framework of existing Polish law and regulations on water and wastewater treatment and operations.

5.4.4 Financial Administration of Water/Wastewater Organizations

This may be considered an advanced course growing out of the previously described management course; at the same time it could also be designed, in part, to be introductory and specific to managers, bookkeepers, and other employees assigned to financial functions within the gmina, or within the water/wastewater organization or company serving the gmina. It should cover in some detail the basis for water/wastewater rates; the design of rate structures; the detail of billing, collection, and accounting; and the relationship between operations and maintenance accounting and accounting for capital expenditures. Best accounting practices in compiling a full annual budget and a capital expenditure budget should be integral to this course.

5.4.5 Planning for Water/Wastewater Management

This course should be considered a continuation of the training on management and financial administration in which the elements of short- and long-range planning for water/wastewater needs are combined. It would deal with such items as planning as a technique to improve management and financial operations; setting priorities; and estimating costs while taking into account likely changes,

contingencies, and practical realities. Emphasis should be put on capital budgeting as a focus of practical planning. Such devices as PERT (Program Education and Review Technique) charting, planning maps, etc., could be introduced as techniques for illustration.

5.4.6 Developing and Writing a Project Business Plan

This course would be given to top-ranking municipal officials and their consultants, if appropriate. The course focus would be putting together a "pre-feasibility" study (i.e., a project business plan) for an infrastructure project for which the gmina would like to attract other-source funding (e.g., from the central government, private investors, foreign banks, and foreign development lending institutions). The first part of the course would review the possible sources for outside funding and their requirements along with the "business plan" formats required by these agencies. The second part would then review the data needed; the manner in which it should be presented in the report; and finally, the writing, editing, and publication of the report. The course would also discuss methods for presenting the report in summary form to the various institutions interested in funding this kind of project.

5.4.7 Management of Infrastructure Projects

One of the most important training courses to be given to all municipalities is one that involves project management. This course should be available to high-level managers and decision makers in the gmina. The course would take a proposed project through the major stages of the project management cycle: preparing a project proposal, completing preliminary studies on design and coverage (with emphasis on appropriate technology as well as operations and management when the project is finished), assessing finances, hiring a design firm, approving the design, preparing detailed project specifications, bidding, awarding the bid, negotiating the contract, administering the contract, inspecting the project, receiving the completed project, and beginning operations. Within each of these steps, best practices would be discussed. A particular project would be employed as a case study for taking participants through the project management procedures. Again, the course would have to be practical and consistent with Polish law.

5.4.8 Design and Implementation of Public Information Programs on the Environment

The object of this training course would be to assist the gmina in designing and implementing various outreach information programs that are concerned with the environment; a secondary object would be to improve communications among the gmina executives, the gmina council, the nongovernmental organizations in the gmina, and the citizens. The course would first introduce the participants to the basic psychology of public information programs (i.e., who is the audience, what is the message, what is the best way to get the message across, what results do you want to achieve). It would also

give background on the various written and visual techniques available and when to use which technique for which audience, message, etc. The course would then choose a particular municipality that has some public information or outreach need, and go through the steps from idea to result. Emphasis should be placed on using available resources and not relying too much on high-tech methods that are costly and impractical to implement.

APPENDICES

APPENDIX A

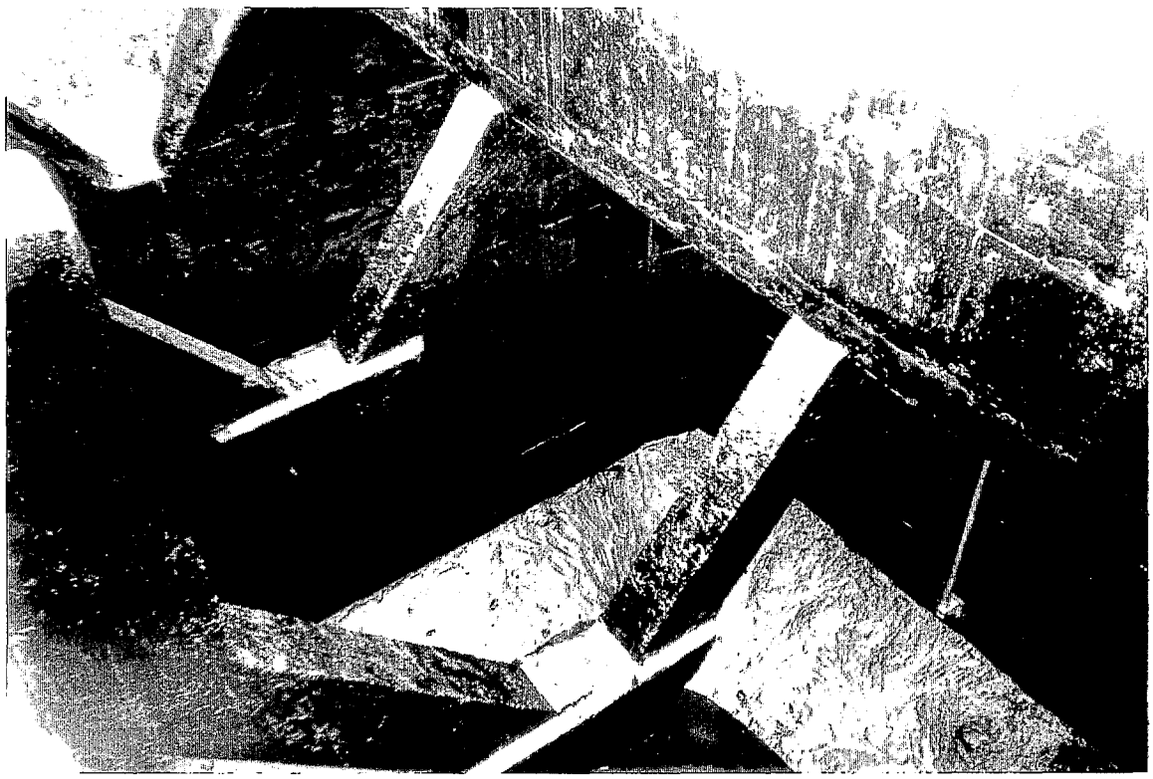
Photographs

1. Krasowicka Struga has been reduced to an odorous, septic stream that is a threat to public health. It empties into the Widawa about 3 km downstream from this point. The Widawa River is regulated in Namysłów. In the town, it receives combined sewer overflows and storm water.

1. Krasowicka Struga została zamieniona w śmierdzący ściek, który jest zagrożeniem dla zdrowia ludności. Wpada on do Widawy około 3 km w dół strumienia od tego miejsca. Rzeka Widawa jest w Namysłowie uregulowana. W mieście wpadają do niej połączone przelewy kanalizacji ogólnospławnej i wody opadowe.

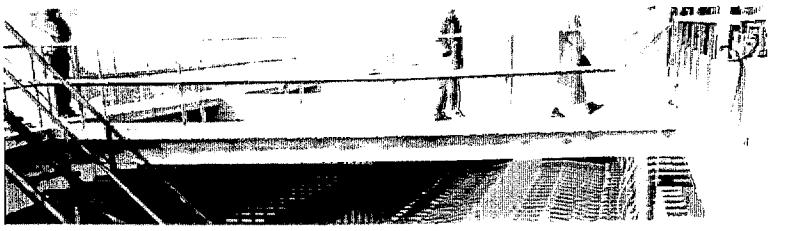
2. Namysłów's wastewater is discharged through the infiltration lagoons located 3.5 km from the sewage treatment plant. The infiltration lagoons are 1.5 m deep, occupy 20 ha of land, and are not used in the new plant now being completed. They will be used initially for storing/dewatering stabilized sludge, until a dewatering station is constructed on the STP premises.

2. Ścieki z Namysłowa odprowadzane są przez pola filtracyjne położone w odległości 3,5 km od oczyszczalni ścieków. Pola filtracyjne mają głębokość 1,5 m, zajmują obszar 20 ha i nie są wykorzystane w nowej oczyszczalni ścieków, której budowa obecnie dobiega końca. W początkowym okresie będą wykorzystywane do składowania/suszenia ustabilizowanego osadu - do czasu budowy stacji odwadniania na terenie oczyszczalni ścieków.



3. The existing Imhoff tanks have been salvaged and could be used in the new municipal STP as phosphorus release tanks, for sludge stabilization, or for pretreatment of wastewater from ZPZ or other industries.

3. Istniejące osadniki Imhoffa zostały zachowane i mogą zostać wykorzystane w nowej Miejskiej Oczyszczalni ścieków jako komory uwalniania fosforu, do stabilizacji osadu lub do podczyszczania ścieków z ZPZ lub innych zakładów przemysłowych.



4. The aeration section of the activated sludge tank at the STP is not separated from the anoxic section (in the foreground). A dividing baffle could be hung from the bridge to induce the plug flow effect. The high-speed stirrers (also in the foreground) should be changed if they fail to keep the solids in suspension.

4. Przedział napowietrzania komory osadu czynnego w oczyszczalni ścieków nie jest oddzielona od przedziału anoksycznego (na pierwszym planie). W celu wywołania efektu przepływu tłokowego należy zawiesić na moście przegrodę. Może zaistnieć potrzeba wymiany szybkich mieszadeł (również na pierwszym planie), jeśli nie będą one utrzymywać zawiesiny.

5. The potato processing factory (ZPZ) processes 350 t/d of potatoes into starch, alcohol, and dried potato cubes. The starch processing facility will be upgraded to reduce the quantity of water used. The load in kilograms per day will not change. Foam in the pretreatment facility will continue to be a problem.

5. Zakłady Przemysłu Ziemniaczanego (ZPZ) przetwarzają 350 t/d ziemniaków na krochmal, alkohol i suszoną kostkę ziemniaczaną. Krochmalnia zostanie zmodernizowana tak, aby zmniejszyć zużycie wody. Dobowe obciążenie ścieków w kilogramach nie ulegnie zmianie. Nie rozwiązany pozostanie problem piany powstającej w podczyszczalni.

6. The ZPZ wastewater irrigation system is overloaded and threatens the Namysłów aquifer located directly below it.

6. System pól irygacyjnych ZPZ jest przeciążony i zagraża warstwom wodonośnym Namysłowa znajdującym się tuż pod nim.

7. Treatment of the distillery wastewater (sometimes containing substances other than just cooling water) is, at best, limited to rapid settling, as illustrated in this flow-through, four-chamber clarifer that discharges settled but still highly concentrated wastewater into a creek. LEM proposes building a more formal treatment facility integrating all wastewater from these often multifunctional agricultural enterprises. Rural distilleries fail to dispose of their slops on land according to environmental recommendations. Slops are often dumped into "secluded" depressions or directly onto the open ground. This contributes to contamination of groundwater already threatened by leaking septic tanks and ditches carrying raw wastewater.

7. Oczyszczanie ścieków gorzelnianych (nie zawsze zawierających tylko wody chłodnicze) jest, w najlepszym wypadku, ograniczone do krótkiej sedymentacji, tak jak pokazuje to ten czterokomorowy osadnik przepływowy, który odprowadza odstane, ale nadal bardzo stężone ścieki, do strumienia. LEM proponuje zbudowanie oczyszczalni z prawdziwego zdarzenia, w której oczyszczane byłyby wszystkie ścieki pochodzące z tych często wielofunkcyjnych przedsiębiorstw rolniczych. Wiejskie gorzelnie pozbywają się wywaru nie przestrzegając zaleceń związanych z ochroną środowiska. Wywar zrzucany jest często do "odosobnionych" zagłębień terenu lub wprost na otwartych terenach. Przyczynia się to do zanieczyszczania wód gruntowych, które i tak są już zagrożone przez nieszczelne szamba i rowy, którymi płyną surowe ścieki.

APPENDIX B

Detailed Calculations by LEM:

Raw Wastewater Balance (including all industries)
Process for Biological Nitrogen and Phosphorus Removal

Detailed Budget of Wastewater
Reaching the Municipal STP in Namysłów

I. BILANS ŚCIEKÓW I ŁADUNKÓW ZANIECZYSZCZEŃ DOPŁYWAJĄCYCH DO CENTRALNEJ OCZYSZCZALNI W NAMYSŁOWIE

1. BROWAR - 1995 r.

1.1. Produkcja piwa w browarze w Namysłowie

	1991	1992
Styczeń	2.343,5 m^3	2.323 m^3
Luty	2.014,8	1.574
Marzec	2.667,6	2.176
Kwiecień	2.724,2	2.453
Maj	2.629,9	2.755
Czerwiec	2.754,4	2.838
Lipiec	3.127,4	3.234
Sierpień	-	3.100
Wrzesień	-	3.070
Październik	-	2.954
Listopad	-	2.280
Grudzień	-	-
razem:	18.258,8 m^3	28.757 m^3
śr. I - VII	2.608,4 m^3	2.479 m^3/m-c
śr. I - XI	-	2.614,3 m^3/m-c

1.2. Średnia ilość wytwarzanych ścieków

Poniedziałek - wtorek

537,9 m^3/d
511,4 m^3/d
1049,3 m^3/d : 2 = 524,7 m^3/d wraz ze śc.byt-gosp. i in.

473,3 m^3/d
446,8 m^3/d
920,1 m^3/d : 2 = 460,1 m^3/d bez śc.byt-gosp. i in.

Przeciętny udział ścieków innych:

524,7 - 460,1 = 64,4 m^3/d = 12,3%

1.3. Średnie ładunki zanieczyszczeń ścieków przemysłowych:

1.3.1. Ścieki przemysłowe /bez garażu i laboratorium/:

BZT_5 - 700,2 kgO_2/d = 1525 gO_2/m^3
ChZT -1322,3 kgO_2/d = 2881 gO_2/m^3

Zawiesiny	-	255,3 kg/d	=	556 g/m^3
Zasadowość	-	640,5 vali/d	=	1,4 $vali/m^3$
Nog	-	3,24 kgN/d	=	7,1 gN/m^3
Pog	-	9,18 $kgPO_4/d$	=	20 gPO_4/m^3
		3,1 kgP/d	=	6,7 gP/m^3
Q śc.przem.	=	460,1 m^3/d		
Q śc.og.	=	524,7 m^3/d		
Q śc.in.	=	64,4 m^3/d = 12,3%		

Q max og.	=	615,6 m^3/d
Nd	=	1,17

Q śc.lab+garaż = 36 m^3/d

Q śc. miarodaj.= 460,1 + 36 = 496,1 = 496 m^3/d

Przyjęto:

Q śr. = 500 m^3/d Nd = 1,16

Q max. = 580 m^3/d Nh = 2,5

1.3.2. Ścieki z garażu i laboratorium

Stężenia zanieczyszczeń w tych ściekach przyjęto jak dla surowych ścieków komunalnych.

BZT_5	-	400 gO_2/m^3	=	14,4 kgO_2/d
ChZT	-	640 gO_2/m^3	=	23,0 kgO_2/d
Zawiesiny og.	-	433 g/m^3	=	15,6 kg/d
Nog	-	73,3 gN/m^3	=	2,6 kgN/d
$N-NH_4$	-	46,7 gN/m^3	=	1,7 kgN/d
Pog	-	16,7 gP/m^3	=	0,6 kgP/d
PO_4^{-3}	-	10,0 gP/m^3	=	0,4 kgP/d
Qśc.gar+lab.	-	36 m^3/d		

1.3.3. Ścieki przemysłowe + z laboratorium + z garażu

BZT_5	-	714,6 kgO_2/d	=	1441 gO_2/m^3
ChZT	-	1345,3 kgO_2/d	=	2712 gO_2/m^3
Zawiesiny og.	-	270,9 kg/d	=	546 g/m^3
Nog	-	18,9 kgN/d	=	38,4 gN/m^3
$N-NH_4$	-	11,8 kgN/d	=	23,7 gN/m^3
Pog	-	3,7 kgP/d	=	7,5 gP/m^3
PO_4^{-3}	-	2,3 kgP/d	=	4,6 gP/m^3
Q śc.	=	500 m^3/d		

Z danych literaturowych wynika, że stężenia Pog w ściekach z browaru ze słodownią wynoszą: 8,6 - 10,1 gP/m^3, średnio 9,3 gP/m^3

Stosunek $\frac{Nog}{Pg}$ = 4,07 - 6,38; śr. 5,12

Przyjmując, że oznaczanie stężenia Pog w ściekach z browaru namysłowskiego jest miarodajne, stężenia związków azotu należy skorygować do poniższego poziomu:

Nog = 18,94 kgN/d = 38,4 gN/m^3

$N\text{-}NH_4$ = 11,78 kgN/d = 23,7 gN/m^3

1.4. Przyrost ilości ścieków i ładunków zanieczyszczeń do 2015r

Podobnie jak dla ścieków komunalnych przyjęto 15%-owy przyrost ilości ścieków z browaru w okresie 1995-2015.

2. FABRYKA LODÓW SCHOLLERA - 1995 r.

2.1. Ścieki surowe - ilości :

Q śr.d = 200 m^3/d

Q max d = Nd x Q śr = 1,4 x 200 = 280 m^3/d

Nd = 1,4 oraz Nh = 2,5

2.2. Ładunki zanieczyszczeń:

Przyjęto następujące stężenia oraz obliczono średnie dobowe ładunki zanieczyszczeń:

BZT_5	-	3030 gO_2/m^3	=	606 kgO_2/d
ChZT	-	5735 gO_2/m^3	=	1147 kgO_2/d
Zawiesiny og.	-	500 g/m^3	=	100 kg/d
Nog	-	94,2 gN/m^3	=	18,8 kgN/d
$N\text{-}NH_4$	-	60,0 gN/m^3	=	12,0 kgN/d
Pog	-	18,4 gP/m^3	=	3,7 kgP/d
PO_4^{-3}	-	11,7 gP/m^3	=	2,3 kgP/d
Q śr.d	=	200 m^3/d		

W istniejących fabrykach lodów Schöllera stężenia ortofosforanów wynoszą: 26,5 - 46,0 gPO_4/m^3, średnio 35,2 gPO_4/m^3= 11,7 gP/m^3.

Stosunek związków azotowych do fosforowych przyjęto jak dla ścieków browarnianych: Nog/Pog = 5,12 i stąd skorygowane stężenia związków azotowych wyniosą:

Nog = 94,2 gN/m^3
$N-NH_4$ = 60,0 gN/m^3

2.3. Przyrost ilości ścieków do 2015 r.

Podobnie, jak w przypadku ścieków komunalnych założono 15%-owy przyrost ilości ścieków z fabryki lodów w okresie 1995 2015 r.

3. MIASTO NAMYSŁÓW - 1995 r.

3.1. Ilości ścieków

Liczba mieszkańców	- 17.000 M
q j.ścieków	- 0,150 m^3/M.d
Nd	- 1,15
Nh	- 1,25
Qśr.d	- 2.250 m^3/d
Qmax.d	- 2.590 m^3/d

3.2. Ładunki zanieczyszczeń w ściekach surowych

BZT_5	= 60 gO_2/M.d	= 1.020 kgO_2/d
ChZT	= 96 gO_2/M.d	= 1.632 kgO_2/d
Zawiesiny og.	= 65 g/M.d	= 1.105 kg/d
Nog	= 11 gN/M.d	= 187 kgN/d
$N-NH_4$	= 7 gN/M.d	= 119 kgN/d
Pog	= 2,5 gP/M.d	= 42,5 kgP/d
PO_4^{-3}	= 1,5 gP/M.d	= 25,5 kgP/d
LM	= 17.000 M	

3.3. Przyrost ilości ścieków miejskich do roku 2015

Założono, że ludność Namysłowa w okresie 1995-2015 wzrośnie o 15%, tj. do 19,500 M. W takiej samej proporcji nastąpi też przyrost ilości ścieków komunalnych.

4. DROBNE ZAKŁADY PRZEMYSŁOWE - 1995 r.

4.1. Ilości ścieków z drobnego przemysłu

Zgodnie z dokumentacją techniczno-projektową miejskiej oczyszczalni ścieków w Namysłowie przyjęto, że średnia dobowa ilość ścieków z drobnego przemysłu w 1995 r. wyniesie:

Qśr.d = 520 m^3/d

Dla zakładów tych założono Nd = 1,3 oraz Nh = 2,5

Qmax.d = Nd . Qśr.d = 680 m^3/d

4.2. Ładunki zanieczyszczeń w ściekach surowych

Stężenia zanieczyszczeń w ściekach z drobnego przemysłu przyjęto jak dla ścieków bytowo-gospodarczych:

BZT_5	= 400 gO_2/m^3	= 209 kgO_2/d
ChZT	= 640 gO_2/m^3	= 334 kgO_2/d
Zawiesiny og.	= 433 g/m^3	= 225 kg/d
Nog	= 73,3 gN/m^3	= 38,0 kgN/d
$N\text{-}NH_4$	= 46,7 gN/m^3	= 23,9 kgN/d
Pog	= 16,7 gP/m^3	= 8,8 kgP/d
PO_4^{-3}	= 10,0 gP/m^3	= 5,7 kgP/d

Qśr.śc.drob.zakł.= 520 m^3/d

4.3. Przyrost ilości ścieków do roku 2015

Podobnie jak dla ścieków miejskich przyjęto, że w okresie 1995-2015 nastąpi przyrost ich ilości o 15%.

5. WODY INFILTRACYJNE I PRZYPADKOWE

5.1. Ilości wód infiltracyjnych

Dla lat 1990-1991 stwierdzono, że ilości wód infiltracyjnych i przypadkowych wahają się w zakresie:

Q w.przyp. = 170-850 m^3/d

Jako miarodajną ilość tych wód przyjęto:

Q w.inf. = 950 m^3/d

5.2. Ładunki zanieczyszczeń

Założono, że wody infiltracyjne nie zawierają zanieczyszczeń organicznych, zawiesin i biogenów.

5.3. Przyrost ilości wód infiltracyjnych do roku 2015

Założono, że na skutek rozbudowy sieci kanalizacyjnej dla potrzeb zwiększonej liczby mieszkańców w mieście, ilość wód infiltracyjnych w 2015 r. wzrośnie o 15%.

6. BILANS I CHARAKTERYSTYKA ŚCIEKÓW ORAZ ŁADUNKI ZANIECZYSZCZEŃ BEZ PODCZYSZCZANIA ŚCIEKÓW PRZEMYSŁOWYCH

6.1. Obliczenia dla roku 1995

6.1.1. Bilans ilości dopływających ścieków - 1995 r.

Źródło	Q sr.d m^3/d	Q śr.h m^3/h	Q max.d m^3/d	Qmax.h m^3/h
Miasto	2250	93,75	2590	134,9
Wody infiltr.	950	39,6	950	39,6
Drobny przem.	520	21,7	680	70,8
Browar	500	20,8	580	60,4
Fabryka lodów	200	8,3	280	29,2
Razem:	4420	184,15	5080	334,9

6.1.2. Bilans średnich dobowych ładunków zanieczyszczeń bez podczyszczania ścieków przemysłowych - 1995 r.

Wskaźnik, jednostka	Miasto	Wody inf.	Drobny przem.	Browar	Fabryka lodów	RAZEM
BZT_5, kgO_2/d	1020	-	209	715	606	2550
ChZT, kgO_2/d	1632	-	334	1345	1147	4458
Zaw.og.,kg/d	1105	-	225	271	100	1701
Nog, kgN/d	187,0	-	38,0	18,9	18,8	262,[illegible]
NH_4^+, kgN/d	119,0	-	23,9	11,8	12,0	166,[illegible]
Pog, kgP/d	42,5	-	8,8	3,7	3,8	58,[illegible]
PO_4^{-3}, kgP/d	25,5	-	5,7	2,3	2,3	35,[illegible]
Qśr.d, m^3/d	2250	950	520	500	200	4420

6.1.3. Charakterystyka surowych ścieków dopływających do oczyszczalni /bez podczyszczania ścieków przemysłowych/ - 199[illegible]

Stężenia zanieczyszczeń surowych ścieków dopływających do oczyszczalni, obliczone jako iloraz ładunków z § 6.2 oraz sumarycznego Qśr.d. ścieków = 4420 m^3/d, wyniosą:

BZT_5 = 577 gO_2/m^3
ChZT =1009 gO_2/m^3
Zawiesiny og. = 385 g/m^3

Nog	=	59,4 gN/m^3
NH_4	=	37,7 gN/m^3
Pog	=	13,3 gP/m^3
PO_4^{-3}	=	8,1 gP/m^3

6.2. Obliczenia dla roku 2015

6.2.1. Bilans ilości dopływających ścieków - 2015

Zakładając, że w okresie 1995-2015 nastąpi przyrost wszystkich rodzajów ścieków o 15% /w tym także wód infiltracyjnych - na skutek wydłużenia sieci kanalizacyjnej o 15%/, charakterystyczne ilości dopływających do oczyszczalni ścieków wyniosą:

Źródło	Q śr.d. m^3/d	Q śr.h. m^3/h	Q max d m^3/d	Q max h m^3/h
Miasto	2588	107,8	2979	155,2
Wody infiltr.	1093	45,5	1093	45,5
Drobny przem.	598	24,9	782	81,5
Browar	575	24,0	667	69,5
Fabryka lod.	230	9,6	322	33,5
Razem:	5084	211,8	5843	385,2
Przyjęto:	5100	212,5	5800	385,0

6.2.2. Bilans średnich dobowych ładunków zanieczyszczeń bez podczyszczania ścieków przemysłowych - 2015 r.

Poniżej przedstawiono ładunki zanieczyszczeń ścieków surowych z poszczególnych źródeł dopływającyeh do oczyszczalni przy założeniu 15%-owego wzrostu ilości ścieków w okresie 1995-2015 oraz identycznych jak w 1995 r. stężeń zanieczyszczeń

Wskaźnik i jednostka	Miasto	Wody inf.	Drobny przemysł	Browar	Fabryka lodów	RAZEM
BZT_5, kgO_2/d	1173	-	240	822	697	2932
ChZT, kgO_2/d	1877	-	384	1547	1319	5127
Zaw.og.,kg/d	1271	-	259	312	115	1957
Nog, kgN/d	215,1	-	43,7	21,7	21,6	302,1
NH_4, kgN/d	136,9	-	27,5	13,6	13,8	191,8
Pog, kgP/d	48,9	-	10,1	4,3	4,4	67,7
PO_4^{3-}, kgP/d	29,3	-	6,6	2,6	2,6	41,1

6.2.3. Charakterystyka surowych ścieków dopływających do oczyszczalni /bez wstępnego podczyszczania ścieków przemysłowych/- 2015 r.

Stężenia zanieczyszczeń ścieków dopływających do oczyszczalni, obliczone jako iloraz ładunków podanych w § 6.2.2. oraz Qśr.d. = 5084 m^3/d, wyniosą identycznie jak w 1995 r.:

BZT_5	=	577 gO_2/m^3
ChZT	=	1009 gO_2/m^3
Zawiesiny og.	=	385 g/m^3
Nog	=	59,4 gN/m^3
NH_4^+	=	37,7 gN/m^3
Pog	=	13,3 gP/m^3
PO_4^{3-}	=	8,1 gP/m^3

6,3. Bilans średnich dobowych ładunków zanieczyszczeń przy założeniu podczyszczania ścieków browarnianych i z fabryki lodów - 1995 r.

6.3.1. Niezbędny stopień podczyszczania ścieków

W celu określenia niezbędnego stopnia podczyszczania ścieków przyjęto, że ścieki z browaru i fabryki lodów byłyby podczyszczane w stopniu spełniającym wymogi nieaktualnego już normatywu dla zrzutu do urządzeń stanowiących własność państwa z uwagi na BZT_5 i ChZT oraz do stężeń charakterystycznych dla ścieków bytowo-gospodarczych z uwagi na pozostałe wskaźniki:

138

Wskaźnik	Stężenia dopuszcz.	Browar		Fabryka lodów	
		stęż.śc.sur.	% red	Stęż. śc.sur.	% red
BZT_5, gO_2/m^3	700	1441	51,4	3030	76,7
ChZT, gO_2/m^3	1000	2712	63,1	5735	82,6
Zaw.og., g/m^3	433	546	20,7	500	13,4
Nog, gN/m^3	73,3	38,4	0	94,2	22,2
NH_4, gN/m^3	46,7	23,7	0	60,0	22,2
Pog, gP/m^3	16,7	7,5	0	18,4	9,2
PO_4^{3-}, gP/m^3	10,0	4,6	0	11,7	14,5

Calculations of the Biological Section of the Namysłów STP, Without Pretreatment of Industrial Wastewater

II. OBLICZENIA URZĄDZEŃ BIOLOGICZNEJ CZĘŚCI OCZYSZCZALNI ŚCIEKÓW MIEJSKICH BEZ PODCZYSZCZANIA ŚCIEKÓW PRZEMYSŁOWYCH

1. DANE WYJŚCIOWE DO PROJEKTOWANIA NA II ETAP - 2015 r.

Q śr d	=	5100 m^3/d		
Q śr h	=	212,5 m^3/h		
Q max d	=	5800 m^3/d		
Q max h	=	385 m^3/h		
BZT_5	=	2930 kgO_2/d	=	577 gO_2/m^3
ChZT	=	5130 kgO_2/d	=	1009 gO_2/m^3
Zaw.og.	=	1960 kg/d	=	385 g/m^3
Nog	=	302 kgN/d	=	59 gN/m^3
Pog	=	68 kgP/d	=	13,3 gP/m^3
NH_4	=	192 kgN/d	=	38 gN/m^3
PO_4^{3-}	=	41 kgP/d	=	8,1 gP/m^3

Zgodnie z decyzją wodno-prawną na zrzut ścieków:

Q	=	8500 m^3/d
pH	=	6,5 - 8,5
BZT_5	=	11,5 gO_2/m^3
ChZT	=	42 gO_2/m^3
Zaw.	=	26 g/m^3
Pog	=	1,5 gP/m^3
Nog	=	10 gN/m^3
$N-NH_4$	=	6 gN/m^3

Przyjęto, że w II etapie /rok 2015/ należy spełnić dla $Q = 5100\ m^3/d$:

$BZT_5 = 15\ gO_2/m^3$
$ChZT = 45\ gO_2/m^3$

2. OBLICZENIA URZADZEŃ WG. WYTYCZNYCH AMERYKAŃSKICH

2.2. KOMORY ANAEROBOWE

2.2.1. Dane wyjściowe do projektowania usuwania P

Q śr.d. $= 5100\ m^3/d = 212,5\ m^3/h$
Pog odpł.$= 1,5\ gP/m^3$

Ścieki surowe posiadają parametry:

$BZT_5 = 577\ gO_2/m^3$
$ChZT = 1009\ gO_2/m^3$
$Pog = 13,3\ gP/m^3$
$ChZT/P = 1009 : 13,3 = 76 \gg 40$
$ChZT/BZT_5 = 1009 : 577 = 1,75 \ll 2$
$\Delta P = 13,3 - 1,5 = 11,8\ gP/m^3$

2.2.2. Parametry procesu

Zgodnie z wytycznymi zawartymi w podręczniku "Design and retrofit of wastewater treatment plants for biological nutrient removal" Randalla i in. wynika, że z uwagi na korzystny stosunek $ChZT/BZT_5$ 2 można dla tej komory przyjąć:

$HRT_{min} = 1,5\ h$ oraz

$$\frac{\text{smo anaerobów}}{\text{smo og}} = 0,15 = 15\%$$

2.2.3. Wymiary komór anaerobowych

$$V_{KA} = Q\ śr.h \times HRT = 212,5 \times 1,5 = 318,8\ m^3 = \sim 320\ m^3$$

Adaptowane na komory anaerobowe osadniki Imhoffa posiadają czynną pojemność $V_1 = 714\ m^3$ każdy, co oznacza czas retencji:

$$t = \frac{V_1}{Q\ śr.h} = \frac{714}{212,5} = 3,4\ h$$

a więc dwukrotnie dłuższy od wymaganego. Może to oznaczać zakłócenia w procesie defosfatacji w wyniku wtórnego uwalniania P.

2.3. KOMORY DENITRYFIKACYJNO-NITRYFIKACYJNE W SYSTEMIE A^2O

2.3.1. Założenia wyjściowe do projektowania

$Q = 5100\ m^3/d$

ChZT śc.sur. = 1009 gO_2/m^3

ChZT śc. po defosf. = 0,90 x 1009 = 908 gO_2/m^3 przy założeniu 10% usuwania ChZT w komorze anaerobowej

BZT_5 śc.sur. = 577 gO_2/m^3

BZT_5 śc. po defosf. = 0,9 x 577 = 519 gO_2/m^3

Nog śc.sur. = 59 gN/m^3; NH_4 śc.sur. = 38 gN/m^3

W ściekach oczyszczonych przyjęto:

ChZT nierozkł.	= 30 gO_2/m^3	
BZT_5	= 15 gO_2/m^3	
Zaw.og.	= 26 g/m^3	
Nog - przyjęto	= 15 gN/m^3	
NH_4	= 6 gN/m^3	
NO_3	= 9 gN/m^3	
T min.	= 10^oC	
DO_N	= 2,0 gO_2/m^3	- tlen rozpuszczony w komorze nitryfikacji
pH buforowe	= 7,2	

Wg "Wastewater Engineering" Metcalfa i Eddy`ego przyjęto:

μ_m /15/	= 0,5	d-1 (nitryfikacja)
Ks	= 1,4	mg N/l
Y_h	= 0,55	g smo/g BZT_5us
k_d /15/	= 0,05	d^{-1}
SF	= 1,6	współczynnik bezpieczeństwa w projektowaniu
X śr.	= 3500 g sm/m^3 = 2500 g smo/m^3	
DO_D	= 0,1 gO_2/m^3	- tlen rozpuszczony w komorze anoksycznej
U_{DN} /20°C/	= 0,1	$gN\text{-}NO_3$/g smo.d
V aerob	= 0,71;	f'_{VSS} = 0,8

2.3.2. Obliczenie komór nitryfikacji i denitryfikacji

WARIANT I:

/1/ Stała przyrostu nitryfikantów w warunkach eksploatacyjnych komory:

$$\mu'_m = \mu_m \, e^{0,098(T-15)} \frac{DO}{KO_2 + DO} [1 + 0,833 (7,2 - pH)]$$

gdzie:

μ_m = 0,5 maksymalna właściwa stała wzrostu nitryfikantów, d-1

T = 10°C

K_{O_2} = 1,3

pH = 7,2

$$\mu'_m = 0,5 \, e^{0,098/10-15/} \frac{2,0}{1,3 + 2,0} [1 - 0,833/7,2-7,2/] =$$

$$= 0,5 \, e^{-0,49} \cdot 0,606 = 0,303 \, e^{-0,49} = \frac{0,303}{e^{0,49}} = \frac{0,303}{1,632}$$

$$= 0,186 \, d^{-1}$$

/2/ Maksymalna szybkość wykorzystania substratów:

$$k' = \frac{\mu'_m}{Y} = \frac{0,186}{0,2} = 0,928 \, d^{-1}$$

/3/ Minimalny wiek osadu:

$$\frac{1}{WO_c^M} = \sim Yk' - kd = 0,2 \cdot 0.928 - 0,05 = 0,1356 \, d^{-1}$$

$$WO_c^M = 7,37 \, d$$

/4/ Projektowy wiek osadu:

$$WO_c = SF \cdot WO_c^M = 1,6 \times 7,37 = 11,8 \, d$$

/5/ Stopień recyrkulacji zawartości komór i osadu powrotnego do komory denitryfikacji:

$$R = \frac{/N\text{-}NH_4/o - /N\text{-}NH_4/e}{/N\text{-}NO_3/e} - 1 = \frac{38 - 6}{9} - 1 = 2,6$$

/6/ Ogólny wiek biomasy nitryfikacyjno-denitryfikacyjnej wyniesie:

$$WO'_c = \frac{WO_c}{V\ aerob.} = \frac{11,8}{0,71} = 16,6\ d$$

gdzie: V aerob. = 0,71 - udział objętości komory nitryfikacyjnej w ogólnej pojemności komór nitryfikacji i denitryfikacji

/7/ Rozkładalną frakcję s m o można obliczyć z równania:

$$f_{VSS} = \frac{f'_{VSS}}{[1 + (1 - f'_{VSS})\, k_d\, WO'_c]}$$

gdzie: f_{VSS} = 0,8 - udział części rozkładalnych biomasy w fazie jej ~~rozruchu~~ wzrostu

$$k_d(10) = k_d(15)\ \Theta^{10-15} = 0,05 \cdot 1,04^{-5} = 0,04$$

$$f_{VSS} = \frac{0,8}{[1 + (1 - 0,8)\, 0,04 \cdot 16,6]} = 0,706$$

/8/ Całkowity czas retencji ścieków w komorze aerobowej + anoksycznej

$$t = \frac{WO'_c\ Y_h\ /So - S/}{X\ a\ [1 + kd\ .\ f_{vss} . WO'_c]}$$

gdzie: Y_h = 0,55 gsmo/gBZT$_5$ - współczynnik przyrostu heterotrofów,

Xa = 2500 gsmo/m^3

$kd_{/10/}$ = 0,04 d^{-1}

$$So - S = 519 - 15 = 504 \ gBZT_5/m^3$$

$$t = \frac{16,6 \cdot 0,55 \cdot 562}{2500 \left[1 + 0,04 \cdot 0,706 \cdot 16,6\right]} = \frac{4601,52}{3671,96} =$$

$$= 1,253 \ d = 30,1 \ h$$

Rożporządzalne gabaryty KDN + KN wynoszą 2295 + 5430 = 7725 m^3 i zapewniają czas retencji 1,51 d = 36,4 h.

/9/ Czas przetrzymania w strefie anoksycznej:

$$t_{DN} = /1 - V_{aerob}/ \ t = /1 - 0,71/ \ 30,1 = 8,73 \ h$$

/10/ Wymagany czas denitryfikacji:

$$t'_{DN} = \frac{N_{Denit}}{U_{DN} \ X_a} = \frac{38-6-9}{0,04 \cdot 2500} = 0,23 \ d = 5,52$$

gdzie: $U_{DN} = U_{DN/20/} \ \Theta^{T-20} \ /1 - DO/ = 0,1 \cdot 1,09^{10-20} \cdot$

$$\cdot /1-0,1/ = 0,09 \cdot \frac{1}{1,09^{10}} = 0,04 \ gN/g\,smo \cdot d$$

/11/ Przyrost biomasy osadu nitryfikantów i heterotrofów:

$$Y_h = 0,55 \ gsmo/gBZT_5us$$

$$\Delta X_v = Y_h \cdot Q \cdot /S_o - S/ = 0,55 \cdot 5,1 \cdot /519 - 15/ =$$

$$= 1414 \ kg \ smo/d$$

/12/ Zapotrzebowanie tlenu:

$$M_{O2} = \frac{Q \ /S_o - S/}{f} - 1,42 \ X_v + 4,57 \ Q \ /N_o - N/$$

gdzie: f = 0,68 - współczynnik przeliczeniowy BZT_5 na BZT całkowite

$$M_{O2} = \frac{5,1 \ /519-15/}{0,68} - 1,42 \cdot 1414 + 4,57 \cdot 5,1 \ /59-6/ =$$

$$= 3780 - 2008 + 1235 = 3007 \ kgO_2/d$$

146

Zdolność natleniania urządzeń do napowietrzania ścieków:

$$OC = \frac{M_{O_2}}{18} = 167 \text{ kg } O_2/h$$

WARIANT II

Przyjęto:

$V_{aerob} = 0,8$

$X_a = 4500$ gsm/m^3 = 3500 g smo/m^3

/6/ Ogólny wiek osadu nitryfikacyjno-denitryfikacyjnego wyniesie

$$WO_c' = \frac{WO_c}{V_{aer}} = \frac{11,8}{0,8} = 14,75 \text{ d}$$

/7/Rozkładalna frakcja biomasy:

$$f_{vss} = \frac{0,8}{1 + /1-0,8/ \cdot 0,04 \cdot 14,75} = \frac{0,8}{1,118} =$$

$$= 0,716$$

/8/ Całkowity czas retencji ścieków w komorze aerobowej i anoksycznej:

$$t = \frac{WO_c \; Y_h \; /S_o - S/}{X_a \;\; 1 + k_d \cdot f_{vss} \cdot WO_c} = \frac{14,75 \cdot 0,55 \cdot 504}{3500 \;\; 1+0,04 \cdot 0,716 \cdot 14,75} =$$

$$= \frac{4088,7}{4978,54} = 0,821 \text{ d} = 19,7 \text{ h}$$

/9/ Czas przetrzymania w strefie anoksycznej:

$$t_{DN} = /1 - 0,8/ \ 19,7 = 3,9 \text{ h}$$

/10/ Wymagany czas denitryfikacji:

$$t_{DN} = \frac{38 - 6 - 9}{0,04 \cdot 3500} = 0,164 \text{ d} = 3,9 \text{ h}$$

/11/ Przyrost biomasy:

$$\Delta X_v = 1414 \text{ kg smo/d}$$

/12/ Wymagana ilość tlenu do nitryfikacji:

$$M_{O_2} = Q \ /kS_o + 4,57 \ TKN/ \qquad kgO_2/d$$

gdzie: k = 1,15 współczynnik przeliczeniowy BZT z syst. nisko obciążonych na nitryfikacyjne

$$M_{O_2} = 5,100 \ /1,15 \cdot 519 + 4,57 \cdot 59/ = 5,1/866,5/ =$$
$$= 4419 \ kgO_2/d$$

$$OC = \frac{1}{18} \ 4419 = 245,5 \ kgO_2/h$$

2.4. PRZERÓBKA OSADÓW

2.4.1. Przyrost osadu nadmiernego

$$Y_h = 0,55 \text{ gsmo/g } BZT_5us = 0,82 \text{ gsm/g}BZT_5us$$

Dobowa masa osadu nadmiernego wynosi:

$$M_{os} = 0,82 \cdot 5,1 \ /577 - 12/ = 0,82 \cdot 5,1 \ , \ 565 =$$
$$= 2363 \text{ kgsm/d}$$

Zakładając uwodnienie osadu W = 98%, jego dobowa ilość wyniesie

$$Q \text{ os nadm} = \frac{2363}{20} = 118 \ m^3/d$$

2.4.2. Grawitacyjne zagęszczanie i chemiczne kondycjonowanie osadu surowego:

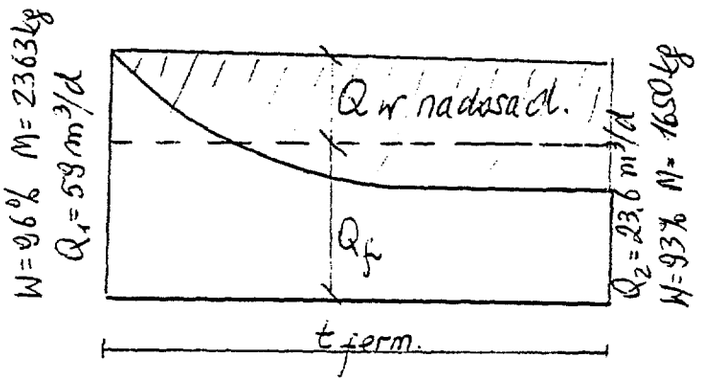
Przyjęto uwodnienie osadu po chemicznym kondycjonowaniu i zagęszczaniu grawitacyjnym:

W = 96% :

$$Q_{os.zagęszcz._1} = \frac{2363}{40} = 59\ m^3/d$$

Zaprojektowany zagęszczacz o pojemności czynnej 70 m^3 i średnicy 4,5 m, głębokości 4,05 + 1,2 jest wystarczający dla właściwego zagęszczenia osadów.

2.4.3. Fermentacja osadu nadmiernego



Ilość wody nadosadowej z procesu fermentacji:

$Q_{w\ nadosad.} = 2/3\ /Q_1 - Q_2/ =$
$= 0,67\ /59-24/ = 23,45\ m$

Przeciętna ilość osadu fermentującego w komorze:

$$Q_f = Q_1 - Q_{w\ nadosad.} = 59 - 23,5 = 35,5\ m^3/d$$

Dyspozycyjna pojemność osadników Imhoffa $V_{WKF} = 3 \times 714 = 2142 m^3$ wystarcza na czas fermentacji:

$$t_f = \frac{V_{WKF}}{Q_f} = \frac{2142}{35,5} = 60,3\ d$$

Uwzględniając, że osad nadmierny posiada wiek 16,6 d - a więc jest już w znacznym stopniu stabilny - czas dofermentowania w warunkach psychrofilnych przez 60,3 d należy uznać za wystarczający.

3. OBLICZENIA URZADZEŃ WG. WYTYCZNYCH NIEMIECKICH

3.1. KOMORA BEZTLENOWA

Wymiarowanie komór DN + N wg normy ATV nr 131 dla temparatury T = 10°C, bez os. wstępnych.

Układ oczyszczania: A_2O

V_B	V_{DN}	V_N

Przyjęto: tp = 1,5 h dla Q śr h

$$V_B = \frac{5100\ m^3}{24} \times 1{,}5\ h = 318{,}75\ m^3 \approx 320\ m^3$$

Przyjęto: w komorze V_B zmniejszenie BZT_5 i ChZT o 10%

3.2. KOMORY DENITRYFIKACJI I NITRYFIKACJI

Parametry ścieków:

$Q_{śr.d} = 5100\ m^3/d$

Ścieki surowe		Po komorze V_B	Wymagana jakość odpływu	
BZT_5	577 mg/l	519	11,5	98%
Zaw.og.	385 mg/l	385	26	
Nog	59,4 mg/l	59,4	10	
Pog	13,3 mg/l	13,3	1,5	

$Ł_{BZT_5}$ na dopływie do komory DN (60 g/Mkd)

$Ł = 5100 \times 0{,}519 = 2646{,}9\ kgBZT_5/d \rightarrow RLM = 44.115$

$Zaw.og/BZT_5 = 385 : 519 = 0{,}74$

$Nog/BZT_5 = 59{,}4 : 519 = 0{,}11$

$Pog/BZT_5 = 13{,}3 : 519 = 0{,}023$

Ilość N wbudowywanego w biomasę: 0,045 $kgN/kgBZT_5$

$N_B = 0{,}045 \times 519 \times 0{,}98 = 22{,}9\ mgN/l$

Azot do denitryfikacji: $N_o = N_o - N_e - N_B$

$N_D = 59{,}4 - 10 - 22{,}9 = 26{,}5\ gN/l$

Wskaźnik denitryfikacji:

$$\frac{N_D}{BZT_5} = \frac{26{,}5}{519} = 0{,}051$$

Wg tabeli 4 przyjęto: $V_D / V_N = 0{,}2$

150

- Wg tabeli 1 - przyjęto wiek osadu WO = 12 d
- Przyrost osadu nadmiernego ze względu na BZT_5 :

  zaw og/BZT_5 = 0,74 WO = 12 d <u>wg tabeli 8:</u>

  <u>ΔX = 0,82 $kgsm/kgBZT_5$</u>

- Zawartość osadu w reaktorze $(X_{śr})$ dla N + DN
  - bez stabilizacji osadu $X_{śr}$ = 3,5 - 4,5 $kgsm/m^3$
- Obciążenie osadu = 1/ /x . wo/ :

$$O_{ł} = \frac{1}{0,82 \cdot 12} = 0,10 \ kgBZT_5/kgsm.d$$

- <u>Obciążenie objętościowe reaktora</u>:

$X_{śr}$ = 3,5 $kgsm/m^3$ O_v = 3,5 x 0,1 = 0,35 $kgBZT_5/m^3d$

$X_{śr}$ = 4,5 $kgsm/m^3$ O_v = 4,5 x 0,1 = 0,45 -"-

- <u>Objętość komory nitryfikacji $V_N = Ł_{BZT_5} : O_v$</u>

$X_{śr}$ = 3,5 $kgsm/m^3$ V_N = 2646,9 : 0,35 = 7562,6 m^3 = ~ 7563 m^3

$X_{śr}$ = 4,5 $kgsm/m^3$ V_N = 2646,9 : 0,45 = 5882,0 m^3

- <u>Objętość komory DN</u> $V_D = 0,2\ V_N$

$X_{śr}$ = 3,5 $kgsm/m^3$ V_D = 0,2 x 7563 m^3 = 1513 m^3

$X_{śr}$ = 4,5 $kgsm/m^3$ V_D = 0,2 x 5882 m^3 = 1176 m^3

- <u>Objętość reaktora</u> $V_c = V_B + V_D + V_N$ <u>dla Q = 5100 m^3/d</u>

$X_{śr}$ = 3,5 $kgsm/m^3$ V_c = 320 + 7563 + 1513 = <u>9396 m^3</u>

$X_{śr}$ = 4,5 $kgsm/m^3$ V_c = 320 + 5882 + 1176 = <u>7378 m^3</u>

- <u>Zapotrzebowanie tlenu</u>

  Dla usunięcia BZT_5: WO = 12 d tab.9

  T^o = 10°C OV_c = 1,22 $kgO_2/kgBZT_5$

  Współczynnik nierównomierności C: f_c = 1,17 /tab10/

151

- Zapotrzebowanie O_2 na nitryfikację /pomijają DN/

$$OV_N = \frac{4,6 \cdot /N_D + N_C/}{BZT_5} = \frac{4,6 /26,5 + 10/}{519} =$$

$$= 0,32\ kgO_2/kgBZT_5$$

Współczynnik $f_N = 1,0$ $\qquad C_x = 2,0\ mgO_2/l$

$C_S = 11,0\ mgO_2/l$

- Maksymalne zapotrzebowanie O_2 ze względu na C /temp.=10°C/

$T = 10°C$ $\qquad O_2 = \frac{C_S}{C_S - C_x} /OV_c \cdot f_c + OV_N \cdot f_N/$

$$O_2 = \frac{11}{11 - 2} /1,22.1,17+0,32.1,0/=$$

$$= \underline{2,14\ kgO_2/kgBZT_5}$$

- Maksymalne zapotrzebowanie O_2 ze względu na N

$$O_2 = 1,22\ /1,22.1,0+0,32.2,0/ = \underline{2,27\ kgO_2/kg}$$

Temp. 20°C $\qquad O_{vc} = 1,51 \qquad WO = 12\ d$

$C_s = 9\ mgO_2/l \qquad N_D = 0,06 \cdot 519 = 31,1\ mgN/l$

$$OV_N = \frac{4,6 \cdot 5,4 + 1,7 \cdot 31,1}{519} = \frac{77,7}{519} = \underline{0,15\ kgO_2/kg\ BZT_5}$$

- Maksymalne obciażenie C

$$O_2 = \frac{9}{9 - 2} /1,51 \cdot 1,17 + 0,175 \cdot 1,0/ = 1,28/1,77+$$

$$+ 0,175/ = \underline{2,48\ kgO_2/kgBZT_5}$$

- Maksymalne obciażenie N $\qquad f_N = 2,0 \qquad f_c = 1,0$

$$O_2 = 1,28\ /1,51 \cdot 1,0 + 0,17 \cdot 2,0/ = \underline{2,37\ kgO_2/kgBZT_5}$$

Dr inż. Janusz Przewłocki

152

APPENDIX C

Critique of Hydrosan Design for the Municipal Sewage Treatment Plant

APPENDIX C

CRITIQUE OF HYDROSAN DESIGN FOR THE MUNICIPAL SEWAGE TREATMENT PLANT

The LEM team was unable to locate any feasibility study that compared optional solutions to the main problems in Namysłów, based on cost-effectiveness analysis. A decision was made to design a full biological nutrient removal (BNR) plant with an anaerobic-anoxic-aerobic sequence. As previously noted, the plant was still under construction in November 1993, and cursory inspections by the LEM team revealed good attention to detail.

The existing Imhoff tanks have been converted to serve as uncovered anaerobic phosphate release tanks receiving return activated sludge (RAS). The new part of the plant consists of a one-tank, one-sludge system with the first portion stirred and not aerated followed by a diffused-air-aeration section. The main concept behind the facility design was to build tanks as large as possible to accommodate the unknown factors and to effect partial stabilization of waste-activated sludge. The design project was never subjected to a rigorous evaluation by experts versed in BNR process design. Itemized comments follow.

1. Justification for the raw wastewater influent parameters selected has not been documented well in the design. There appears to have been no analysis of the existing data on the wastewater reaching the plant. The concentration of nutrients appears to have been underestimated. There were no provisions in the raw concentration calculations for the ice cream manufacturing plant load, which may be quite substantial (estimated at up to 600 kg BOD_5/d).

2. The main denitrification and nitrification (DEN/NIT) reactor does not offer the flexibility to allow development of an operational procedure for optimizing nutrient removal. There are no baffles and there is no provision for alternative management of mixed liquor returns.

3. The DEN/NIT tanks are rather wide (10 m), which may contribute to longitudinal mixing and offset the desired plug-flow effect. The cross mixing-inducing stirrers in the anoxic compartment will also contribute to the complete mixing effect.

4. The phosphate release tanks are converted from the existing Imhoff tanks. It is an elegant solution; however, these tanks may have an excessive volume for that purpose. With the normally recommended hydraulic residence time (HRT) of 1 to 1.5 hours for this type of the process, the use of only one tank (in dry weather) may already be creating unfavorable conditions for the nitrifying population in the recycled activated sludge. It also may cause the production of propionate and stronger acids that are detrimental to biological phosphorus release.[1] This comment is speculation

[1]C. Randall, J. Barnard, and D. Stensel, *Design and Retrofit of Wastewater Treatment Plants for Biological Nutrient Removal* (Lancaster: Technomic Publ., 1992).

on LEM's part and will have to be tested in practice, since the wastewater in Namysłów is very site-specific.

5. Only one of the two final clarifiers designed is being built. This is in contravention to the minimum-redundancy rule (i.e., a minimum of two pieces of equipment, to avoid complete process failure in the event of malfunction). There are no contingency measures for operation of the three activated sludge reactors, serviced by one clarifier.

6. The grit removed from the grit tank is not dewatered mechanically and thus may be a malodorous and aesthetic nuisance at the plant.

7. The calculations of the biological part of the process were based on an assumption of 8 °C as the lowest temperature. Given that real wastewater was already there, it was essential to do actual winter measurements of the temperature of raw sewage at the head of the existing sewage treatment plant. It should be noted that there are no documented cases of biological phosphorus (bio-P) removal anywhere in the world at temperatures below 10 °C. LEM is of the opinion that the temperature will never fall below 10 °C and the initial data collected by the Water Company personnel seem to support that assumption. Temperatures were measured to be 16-17 °C when collected on 5, 6, 7, 8, 9, and 10 November 1993, with ambient temperatures often close to freezing, and overnight frost.

8. The size of the reactors was based on values selected from the literature. It is unfortunate that no treatability studies were done for this very nontypical wastewater mixture.

9. Sludge quantities were underestimated. Erroneous calculations of the amount of excess sludge were compounded by the omission of the primary sludge from the mass of sludge directed for sludge processing.

10. Sludge handling was not adequately addressed, and the recommended solution of using the Draimad® Teknobag® (according to Daimad literature) is applicable only to small plants generating below 200-400 kg dry solids per day. Namysłów is a much bigger operation.

11. Recommendation of the type of the chemical sludge conditioning program, including specifying by brand name the chemicals to be used, is inadvisable. The type of chemical, its electrical charge and dose, and particularly the choice of manufacturer, must be based on a competitive bid system supported by field studies. Otherwise the gmina <u>will always pay too much</u> for its chemical program.

12. Specification of the trickling filter as a pretreatment unit on the site of the main STP has not been justified through a formal cost-effectiveness analysis. Operation of a plant-within-plant in this manner, and the resulting temperature drop due to trickling filtration, are drawbacks. If they are to be applied, a formal technical justification

should be given to show superiority to combined treatment in one tank of the main STP.

13. The assumed BOD reduction at the pretreatment plant has not been justified and appears unrealistic due to the high organic load applied to the trickling filters (in excess of 3 $kg/m^3 \bullet d$).

14. The design does not deal with the utilization of the existing infiltration lagoons. It should be noted that due to anaerobiosis, their usefulness for sludge storage (this was one option that was discussed) may be questionable—unless the leachates are contained and/or treated. Anaerobiosis releases the phosphate contained in sludge.

15. There is no formal laboratory to help the operators run the plant. This is an indispensable, nonnegotiable need at a plant of this size and where there is a necessity for close process control.

16. There is no instruction manual for operation. Such a manual, including a detailed troubleshooting section, is necessary.

17. Operating costs for the design were not compared with costs for alternative solutions.

APPENDIX D

Cost Calculations for Three Solutions to the Problem of Wastewater from the ZPZ Potato Processing Plant

Table D-1

OPTION 1: COMBINED TREATMENT OF ZPZ WASTEWATER WITH SEWAGE AT MAIN STP

Solution with unlimited funds,
providing tertiary quality effluent as per permit

S/N	Item	Cost, billions of złotys	Explanation and comments
1.	Pumping station and pipeline to STP	4.5	Separate pipeline to the pretreatment facility
2.	Refurbishing of 3 Imhoff tanks for anaerobic pretreatment	5.5	1.5 billion for tank and gas handling. Includes distribution pipes
3.	Addition of an anaerobic phosphate release compartment to all trains	1.5	Hanging plastic baffle
4.	One additional full anoxic/aerobic train	9.0	1 million zł/m^3; need approx. 2000 m^3. Aerators; added blower; pipes
5.	Final clarifier	4.5	There would be 3 final clarifiers as a result
6.	Additional pumps, increased sludge handling	2.0	Recycle pumps, miscellaneous
7.	Aerobic digester-thickener	2.0	Intermittent digester-thickener added in place of the Imhoff tank. 1000 m^3 × 2 million zł/m^3
	TOTAL	29 billion zł	

Note: Partial solution has been indicated in Chapter 2. At a cost of 16 billion zł, the combined facility may generate secondary-quality effluent (BOD > 30, N < 30, P < 5 mg/L).

158

Table D-2

OPTION 2: LAND DISPOSAL OF THE ZPZ POTATO PROCESSING WASTEWATER IN THE NEW AREA

S/N	Item	Cost, billions of złotys	Explanation and comments
1.	Main pressure line to the new location	3.0	1 million zł/m^3; 3 km. Use of the existing pumping station
2.	Installation of underground pipes in the fields	14.4	180 ha
3.	Drainage ditches	27.0	150 m/ha; 1 million zł/m
4.	Sprinklers	5.2	3/ha @ $500 each
	TOTAL	50 billion zł	

Note: According to IMUZ (Institute for Agricultural Land Irrigation) in Wrocław and Warsaw, the ballpark cost should be as high as 400 million zł/ha (June 1993 data). Then the total cost would be 72 billion zł. LEM believes the latter costs are overestimated, even though they do not include the cost of land.

Table D-3

OPTION 3: SEPARATE WASTEWATER TREATMENT FOR ZPZ ON SITE; SECONDARY EFFLUENT QUALITY ACHIEVED; PHOSPHORUS AT 5 mg/L

S/N	Item	Cost, billions of złotys	Explanation and comments
1.	Anaerobic lagoon 6-10 m deep; lined and covered	19.0	HRT = 11 days @ 1975 m^3/d; 0.8 million/m^3 (depth)
2.	Aeration reactor - SBR operation	2.0	Aeration reactors from converted (existing) clarifiers
3.	Aerators, decanters, pumps for sludge recycle	3.0	Equipment for the aeration basin and anaerobic lagoon
4.	Gas handling, auxiliary equipment	2.0	Storage or flaring the gas. Power generation would raise the costs further
5.	Roads, power, etc.	3.0	Includes landscaping, lab/ administration building
6.	Sludge handling	1.0	Use of gmina's transportable dewatering facility
	TOTAL	30 billion zł	

Note: A plant of this size, when built for nutrient removal, and in concrete — similar to the Namysłów STP — should cost (based on equivalent population) 6 million zł/(m^3/d) @ 250 mg/L BOD_5. For ZPZ, with its high load after 65% removal of BOD in pretreatment of 1975 m^3/d, with concentration of (7414 kg/d × 0.65) / (1975 m^3/d) = 2440 mg/L, and assuming effluent from the anaerobic lagoon to have S_O = 300 mg/L, the cost could well reach 22 billion × [6 million • 1975 • (300/250)] = 41 billion zł.