4.6.7 Conclusion and Recommendation

The recommended improvement plan for the Birzai Sewerage System is summarized as follows:

1. Sewage Collection System Improvement
   - Water Company must make an effort to prevent stormwater from intruding in the sewers;
   - Investigation of the infiltration of groundwater into the sewers is recommended. Budget may need to be allotted for this purpose.
2. Sewage Treatment System

   Common to Options 1 and 2
   - Construct a new treatment plant at the formerly proposed site outside the town boundary;
   - Abandon the existing treatment plant upon completion of the new treatment plant;
   - New treatment plant will be designed to treat 5,000 m^3/day sewage as a daily maximum flow. The plant will employ the previously designed treatment method that is a so called anaerobic-anoxic-aeration (A2O) method for secondary treatment;
   - Excess sludge will be treated by gravity thickening and mechanical dewatering using a centrifuge;
   - For emergency case if the dewatering machine breaks down, a sludge lagoon having one month storage will be provided; and
   - Dewatered sludge will be transported outside the plant for composing.

   For Option 1
   - Treated effluent will be discharged to the Juodupe River by gravity through a 3.2 km RC discharge pipe;
   - A tertiary treatment process using a biological membrane filter will be used for the secondary effluent to meet the special requirement for the effluent discharged to the Tatula River.

   For Option 2
   - Treated effluent will be discharged to the Obelaukias River by pumping through a 7 km long discharge pipe made of ductile iron;
   - No tertiary treatment process is required.
   - For discharging the effluent to the Obelaukias River, pumps will be provided at the treatment plant.

4.7 PRELIMINARY DESIGN OF THE PROPOSED FACILITIES

4.7.1 General

A preliminary design of the proposed facilities for a sewage treatment plant and a discharge pipeline is presented based on the recommendation described in the previous section. Detailed preliminary drawings are presented in the volume of Drawing in the Supporting Report. This section presents the engineering details of each facility of the sewage treatment plant.

4.7.2 Required Land Area of the Sewage Treatment Plant

For the proposed treatment facility, the required land area is estimated at 2.7 ha as shown in the plant layout in Figure 4.8. This land area is smaller than the previously proposed scheme that required a land area of approximately 5 ha.

4.7.3 Design Basis

Design basis of the treatment plant is summarized in Table 4.18.

Table 4.18 Design Basis of the Treatment Plant

Item	Value		Remark
Design Flow			
Daily Average Flow	4,200 m^3/day		used for computing sludge amount and operation cost
Daily Maximum Flow	5,000 m^3/day		used for design of biological reaction tank and sludge treatment
Hourly Peak Flow	6,930 m^3/day		used for design of pipelines, inlet works and sedimentation tank
Influent Quality			BOD$_5$ is used for design of the biological treatment system.
BOD_7	260 mg/l		
BOD_5	230 mg/l		
COD	500 mg/l		
Total-N	40 mg/l		
Total-P	10 mg/l		
Suspended solid	260 mg/l		
Design Effluent Quality (Secondary Treatment)	Cave.	Cmax.	LAND 10-96
BOD_7	15 mg/l	25 mg/l	
BOD_5	13 mg/l	22 mg/l	
COD	75 mg/l	120 mg/l	
Total-N	20 mg/l	35 mg/l	
Total-P	1.5 mg/l	2.5 mg/l	
Suspended solid	30 mg/l	45 mg/l	
Design Effluent Quality (Tertiary Treatment)	Cave.	Cmax.	Special requirement for the Tatula River (to be applied for Option 1)
BOD_7	4 mg/l	8 mg/l	
BOD_5	3.5 mg/l	7 mg/l	
Total-N	8 mg/l	14 mg/l	
Total-P	1.0 mg/l	1.5 mg/l	
Minimum temperature	7°C		

4.7.4 Sewage Treatment Plant

The proposed treatment plant consists of the facilities as follows (detail of the preliminary design is presented in Main Report):

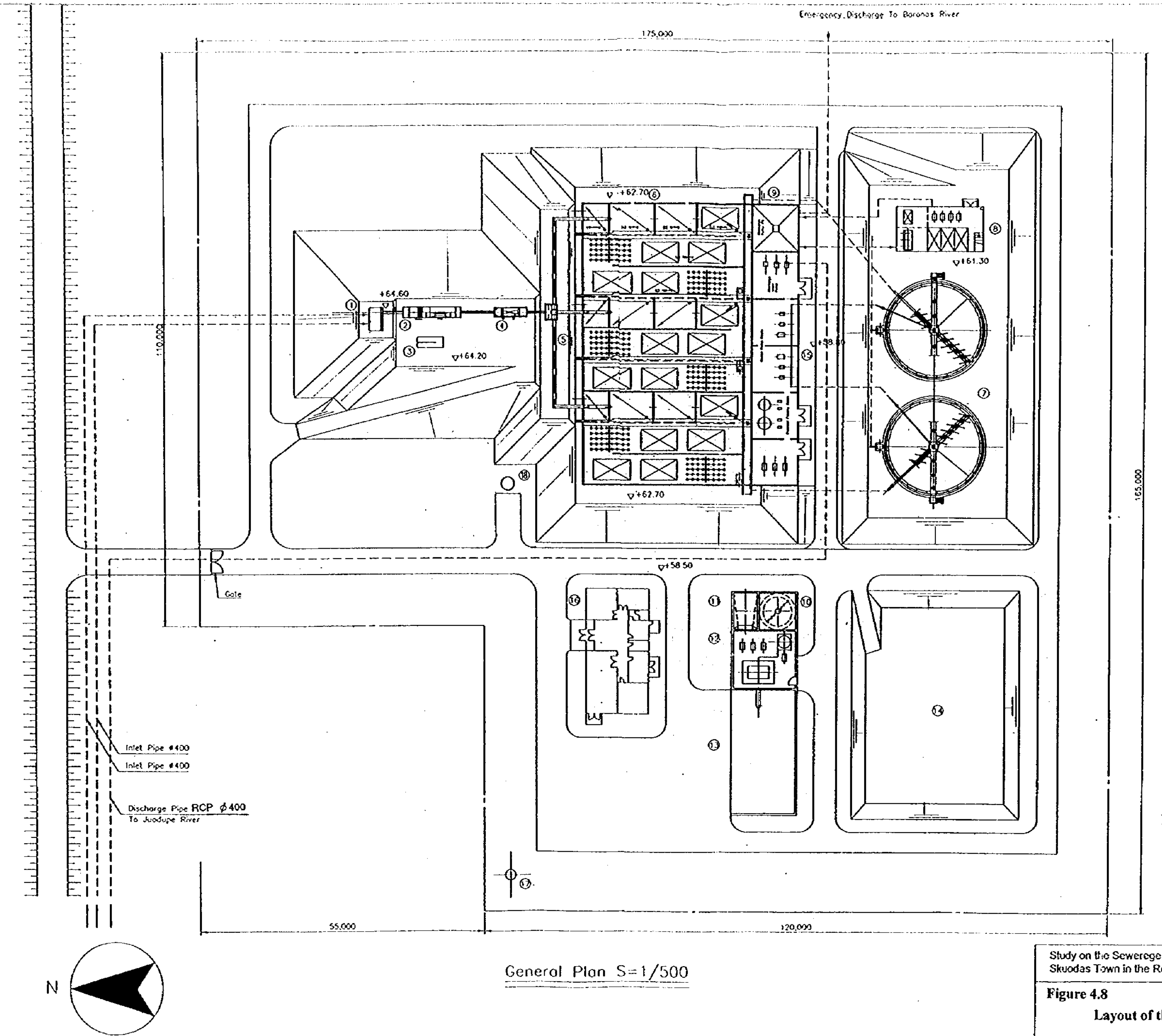
- Grit Chamber
- Parshall Flume
- Biological Reaction Tank
- Final Sedimentation Tank
- Sludge Return Pumps
- Effluent Discharge Pump (for Option 2 only)
- Sludge Pumps
- Sludge Thickener
- Sludge Storage Tank
- Sludge Dewatering Machine
- Sludge Storage Yard
- Sludge Lagoon
- Chemical Feeding Facility
- Septage Receiving Tank
- Tertiary Treatment Facility (for Option 1 only)
- Administration Building
- Sludge Building
- Equipment Room
- Effluent Discharge Pipeline

For Option 1

Total length:	3,250 m
Diameter of pipe:	400 mm
Material of pipe:	Reinforced concrete

For Option 2

Total length:	7,000 m
Diameter of pipe:	300 mm
Material of pipe:	Ductile iron



Item Of Facility

1. Receiving Well
2. Grit Chamber
3. Sand Bed
4. Parshal Flume
5. Spliter Box
6. Reaction Tank
7. Final Sedimentation Tank
8. Biological Membrane Filter (Option 1 only)
9. Discharge Pump Pit
10. Sludge Thickener
11. Sludge Storage Tank
12. Sludge Treatment Building
13. Sludge Stock Yard
14. Sludge Lagoon
15. Equipment Room
16. Administration Building
17. Deep Well
18. Septage Receiving Tank

Study on the Sewerage System Improvement of Biržai and Skuodas Town in the Republic of Lithuania

Figure 4.8

Layout of the Proposed Treatment Plant

4.8 CONSTRUCTION PLAN AND PROJECT COST ESTIMATES

4.8.1 Construction Schedule

An overall construction schedule for Birzai is presented in Figure 4.9. The schedule for Birzai is some 13 months long including the demolition of the existing treatment plant. A facilities construction schedule, shown in Figure 4.10, shows a schedule for the various components of the work.

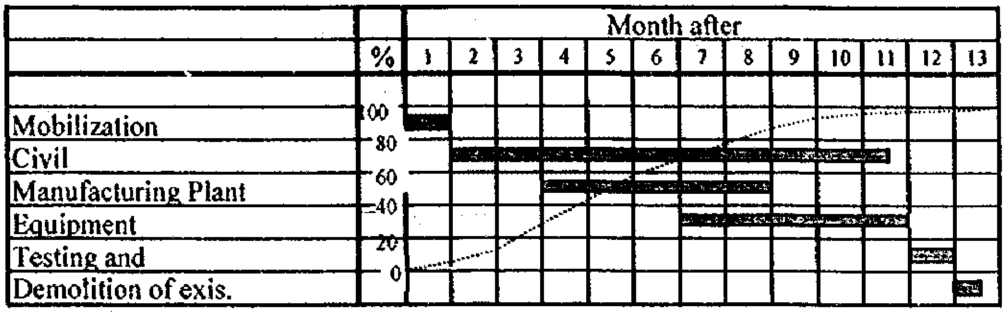


Figure 4.9 Overall Construction Schedule

4.8.2 Construction Supervision

To obtain a quality product on time, within the construction funding limit, it is necessary to have full time inspection/supervision of the contractor's activities. It is proposed that the design engineer also perform the inspection/supervision work to avoid design/construction disputes and for a better, more prompt interpretation of the contract documents. A construction resident manager would report directly to the Ministry of the Environment and the Water Company on the physical and financial status of the work. Under each resident engineer would be several resident inspectors and technicians. Specialists in other disciplines would be available as needed from the design engineer's office.

4.8.3 Construction Costs

The construction costs for the two Options for the Birzai project are shown in Table 4.19 and Table 4.20.

Demolition involves removing all above ground structures and buildings from the existing treatment plant site, removing all slabs at grade, cracking of the bottoms of below grade structures so water will not accumulate, filling all below grade tanks and basins with earth or sand to ground level, salvage of all reusable equipment or material, removal of off-site services (electricity, telephone, water and heat/hot water), and removing all unused equipment and materials, trash and waste from the site.

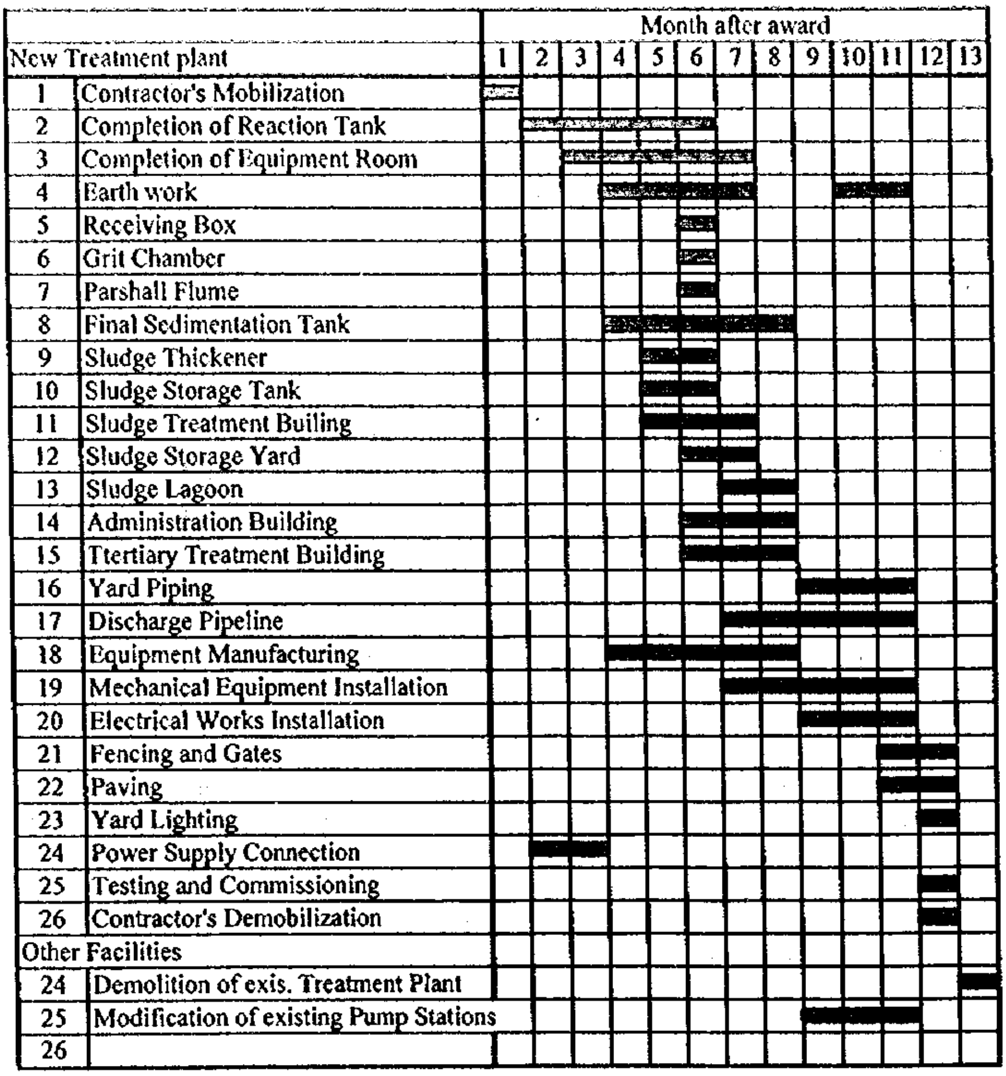


Figure 4.10 Facilities Construction Schedule

4.8.4 Operational Cost

Operational costs for the project include operation and maintenance labor, social insurance, and other related costs. Since these costs occur on an annual basis, the present worth has been calculated and added to construction to obtain the project cost.

Other operational costs include outside services for electrical energy, laboratory analysis, spare parts and small tools, telephone and telemetry, solid waste collection and disposal, fuel supply and chemical supplies. It is planned to use plant personnel for screenings and grit disposal at a nearby landfill. Dried sludge will be provided to local farmers as a soil conditioner and low-level fertilizer. A potable water supply system would be included in the plant design. Sewerage service would also be included in the plant design through a sewer system pumping to the plant headwork's. A heat and hot water system would also be provided by an in-plant system for the Administration Building. A plant water system would provide treated effluent for washdown, toilet flushing, fire protection, water seals and chemical solution water when applicable. Operational costs for Birzai are shown in Table 4.21.

Table 4.19 Construction Costs for the Birzai Treatment Plant (Option 1)

		Amount (Litas)	% of F/C	F/C (Litas)	L/C (Litas)
Construction Cost					
Treatment Plant (secondary treatment process)					
1 Structures		2,346,048			
1 Grit chamber	14,771		50%	7,385	7,385
2 Parshall flume	8,210		50%	4,105	4,105
3 Splitter Box	5,484		50%	2,742	2,742
4 Completion of structures of reaction tank and sedimentation tank	139,058		50%	69,529	69,529
5 Modification of sedimentation tank structure	127,461		50%	63,731	63,731
6 Final sedimentation tank	561,028		50%	280,514	280,514
7 Sludge thickener	89,926		50%	44,963	44,963
8 Sludge storage tank	72,311		50%	36,155	36,155
9 Sludge treatment building	157,300		30%	47,190	110,110
10 Sludge storage yard	482,646		50%	241,323	241,323
11 Administration building	587,853		30%	176,356	411,497
12 Miscellaneous structures	100,000		30%	30,000	70,000
2 Earth Work		9,796	30%	2,939	6,857
3 In-plant Piping		135,348	70%	94,744	40,604
4 Site Development		537,123	30%	161,137	375,986
5 Water Supply Facility		100,000	70%	70,000	30,000
7 Landscaping		50,000	30%	15,000	35,000
6 Plant Equipment		4,512,000	80%	3,609,600	902,400
Treatment plant (secondary treatment process)		7,690,315			
Treatment Plant (tertiary treatment process)					
Biological membrane filter unit (building and plant equipment system)		1,300,000	70%	910,000	390,000
Structures/building	280,000				
Plant equipment	1,020,000				
Effluent Pipeline to the Juodupe River					
RCP dia.400 mm, L = 3,250 m		975,000	30%	292,500	682,500
Demolition of the Existing Treatment Plant		50,000	30%	15,000	35,000
Expansion of Pump Station Monitoring System and Structural Repair		150,000	80%	120,000	30,000
Total Construction Cost		**10,165,000**		**6,294,913**	**3,870,402**

Table 4.20 Construction Costs for the Birzai Treatment Plant (Option 2)

		Amount (Litas)	% of F/C	F/C (Litas)	L/C (Litas)
Construction Cost					
Treatment Plant (secondary treatment process)					
1 Structures		2,346,048			
1 Grit chamber	14,771		50%	7,385	7,385
2 Parshall flume	8,210		50%	4,105	4,105
3 Splitter Box	5,484		50%	2,742	2,742
4 Completion of structures of reaction tank and sedimentation tank	139,058		50%	69,529	69,529
5 Modification of sedimentation tank structure	127,461		50%	63,731	63,731
6 Final sedimentation tank	561,028		50%	280,514	280,514
7 Sludge thickener	89,926		50%	44,963	44,963
8 Sludge storage tank	72,311		50%	36,155	36,155
9 Sludge treatment building	157,300		30%	47,190	110,110
10 Sludge storage yard	482,646		50%	241,323	241,323
11 Administration building	587,853		30%	176,356	411,497
12 Miscellaneous structures	100,000		30%	30,000	70,000
2 Earth Work		9,796	30%	2,939	6,857
3 In-plant Piping		135,348	70%	94,744	40,604
4 Site Development		537,123	30%	161,137	375,986
5 Water Supply Facility		100,000	70%	70,000	30,000
7 Landscaping		50,000	30%	15,000	35,000
6 Plant Equipment		4,562,000	80%	3,649,600	912,400
Treatment plant (secondary treatment process)		**7,740,315**			
Effluent Pipeline to the Obelaukias River DIP dia.300 mm, L = 7,000 m		7,325,000	80%	5,860,000	1,465,000
Demolition of the Existing Treatment Plant		50,000	30%	15,000	35,000
Expansion of Pump Station Monitoring System and Structural Repair		150,000	80%	120,000	30,000
Total Construction Cost		**15,265,000**		**10,992,413**	**4,272,902**

Table 4.21 Operational Costs

(unit: Litas/year)

Item	Option 1 (with Tertiary Treatment)	Option 1 (without Tertiary Treatment)	Option 2
Power cost	106,900	85,250	102,400
Chemicals/Fuel	71,000	71,000	71,000
Fuel and Spare Parts/Tools	89,000	73,250	73,250
TOTAL	266,900	229,500	246,650

4.8.5 Other Costs

Other costs shown in Table 4.22 include land acquisition and engineering costs. Land acquisition or rental of easements for discharge pipeline construction and maintenance and at the effluent discharge points to the rivers must be obtained prior to construction to avoid claims from the contractor for delay. Usually, the Ministry or Water Company obtains any required land for the project and costs for repayment are not included in any project grants or loans.

While the proposed treatment plant site is owned by the Water Company, not all land for the effluent pipeline and maintenance road have been acquired.

Table 4.22 Other Costs

unit: Litas

Item	Option 1	Option 2
Land/Easements	5,000*	-
Engineering (10% of construction cost)		
Final Design	406,560	610,600
Construction Supervision	609,840	915,900
TOTAL	1,021,400	1,526,500

* Option 1 needs land acquisition for discharge pipe for about 800 m.

4.8.6 Project Cost

The final project cost is shown in Table 4.23 and includes the construction cost, operation and maintenance cost, and other costs including land acquisition, and engineering cost and a project contingency of five percent.

Table 4.23 Project Cost (Option 1)

(1000 Litas)

Item	Foreign Cost	Local Cost	Total Cost
Construction Works	6,295	3,870	10,165
Other Costs	712	309	1,021
Contingency (5%)	346	213	559
TOTAL PROJECT COST	7,353	4,392	11,745

Table 4.24 Project Cost (Option 2)

(1000 Litas)

Item	Foreign Cost	Local Cost	Total Cost
Construction Works	10,992	4,272	15,265
Other Costs	1,068	458	1,526
Contingency (5%)	605	235	840
TOTAL PROJECT COST	12,665	4,965	17,631

4.9 FINANCIAL, ECONOMIC AND SOCIAL ANALYSIS

4.9.1 Financial Analysis

4.9.1.1 Basis of Financial Analysis

A financial model has been constructed, focusing on cash-flow forecasting, to conduct a financial analysis of the Project. Tariff required to recover the operating costs and to pay back the loan (both the principal and the interests) has been projected in comparison with financing sources with different costs.

4.9.1.2 Financial Resources Assumed

Main financial resources are assumed as follows:

State Grant/Subsidy

Considering the difficult financial situation of both the Birzai Water Company and Birzai municipality, some subsidy from the state budget may be necessary for financing the project implementation. The state subsidy is assumed at 50 percent of the total investment cost.

Loan from foreign official aid or commercial institutions

With the tight limitation of the tariff increasing, the feasibility of the Project will depend largely on the loan with the lowest cost and most favorable conditions (grace period, e.g.)

Cash reserve of the Birzai Water Company is assumed not to be used for the initial investment, nor to be reinvested in any additional investments during the project period.

4.9.1.3 Effects of Inflation

Inflation will have a great effect on the project. In the analysis, all the costs, except for the depreciation, maintenance and spare parts, taxes, and preparation for bad receivables are assumed to rise at the inflation rates assumed.

All the initial investment costs have been calculated in the future price, using the inflation rates assumed.

Considering that the project will probably use a fixed interest rate loan, and also from the view point of real value for tariffs, the moderate (lower) rates are assumed as follows:

Period	Inflation Rate (see Section 2.3.4.2)
1998	6.1%
1999	5.9%
2000 and after	5.0%

4.9.1.4 Project Period

In the financial analysis, a 25-year period is used with following considerations:

- In accordance with the financial conditions of foreign aids, pay-back period is more or less 25-year including a grace period.
- This period seems reasonable from the facility life and depreciation period of the equipment.

4.9.2 Financial Performance

Using the financial model, the financial performance has been projected and analyzed, focusing the FIRR and tariff required to recover the total cost.

4.9.2.1 Financial Internal Rate of Return (FIRR)

FIRR was calculated for the case of the leveraged finance with a state subsidy/grant for 50 percent of the investment cost and with some soft loan (lower cost) financing for the balance of 50 percent. Conditions for the soft loan is assumed at an interest rate of 7 percent and 10-year grace period such as the Nordic Investment Bank(NIB) loan. Tariff is set at in the beginning, 1.74Lt/m^3 for Option 1 and 1.88Lt/m^3 for Option 2, respectively. FIRR is then calculated at about 5 percent as a hurdle rate which is considered by some official institutions as a benchmark for public projects.

4.9.2.2 Cost Recovery

In the model using the leveraged finance (state subsidy 50% plus low cost loan 50%) as assumed above, the tariff level at the beginning for cost recovery is predicted at 1.692Lt/m^3 for Option 1 and 1.818Lt/m^3 for Option 2, respectively. This means that from that tariff at the beginning of the operation and through 25-year operation, the project will just recover the operation cost and pay back the loan (both the principal and the interests).

To maintain the sustainable management, some positive level of FIRR should be assumed. If the benchmark of 5 percent FIRR should be applied, the sustainable tariff is predicted at 1.74Lt/m^3 for Option 1 and 1.88Lt/m^3 for Option 2, respectively.

From the current tariff (1.16Lt/m^3 for domestic users and 1.17Lt/m^3 for industries users), the predicted tariffs represent an total increasing of 49.7 percent (Option 1) and 61.8 percent (Option 2) in 3-year period, equal to the average increasing rate of 14.4 percent (Option 1) and 17.4 percent (Option 2) per year.

4.9.2.3 Sensitivity Analysis

For the case of Option 1, the initial tariff can be set at 1.65Lt/m^3, if the interest cost is 5 percent. It should be set at 1.74Lt/m^3, if the interest cost is 7 percent, while it should be further raised to 1.83Lt/m^3, if the interest cost is 9 percent.

For the case of Option 2, the initial tariff can be set at 1.75Lt/m^3, if the interest cost is 5 percent. It should be raised to 1.88Lt/m^3, if the interest cost is 7 percent. It will be further raised to 2.01Lt/m^3, if the interest cost is 9 percent.

The effect on the tariff from the beginning to the end of the repayment period, of the different interest cost, are as follows:

Tariff (Lt/m^3) predicted in different interest costs are presented below:

Table 4.25 Projected Tariff to Achieve 5% FIRR

Interest Rate of Loan (%)	Tariff (Lt/m^3)		
	First Year	10th year	25th year
(Option 1)5	1.65	2.19	3.53
7	1.74	2.31	3.72
9	1.83	2.43	3.92
(Option 2)5	1.76	2.34	3.76
7	1.89	2.52	4.05
9	2.03	2.70	4.35

4.9.3 Conclusions and Recommendations

Through the use of the financial model, the financial feasibility has been analyzed; the tariff required to recover the operating cost and to pay back the loan have been predicted; and the sensitivity of the tariff and FIRR to the variance of some important factors have been studied.

As a conclusion of the financial analysis, the following recommendations are proposed.

(1) Tariff Structure

- Tariff should be set not only to recover the operating cost, but also to pay back the loan (both the principal and the interests).
- In setting the tariff, a certain level of FIRR should be fully considered, in order to maintain a sustainable management of the Water Company.
- The bench marking of 5 percent of FIRR should be a standard for the project.
- If finance can be arranged for 50 percent from the state subsidy/grant and for 50 percent from the loan at the cost below the level of 7 percent, the required tariff in the first year is predicted at 1.74Lt/m^3 for Option 1, 1.88Lt/m^3 for Option 2. It should then increase once every two years during the first 4-year period, and once every 3-year for the remaining period of the project, both by 10 percent.
- The above predicted tariff may be affordable to the users for the reasons as follows:
  - The current tariff (1.16Lt/m^3) is at the lower level in the country, and should has some room to be raised.

- Increase in tariff is considered modest during the whole repayment period that is 10 percent in every three years, while inflation rates is 5 percent every year. This is equal to 15.7 percent every three years.

(2) Selection of Funding Source

Considering the economic development, family income and municipality budget is not expected to increase quickly, so it is difficult to expect the volume of both water and sewage will increase greatly.

The feasibility of the project will largely depend on utilizing the loan with low cost and other favorable conditions. Grace period is also important for the project, considering the heavy financial burden in operation during the first ten years.

A funding source should be selected so that the project will be operated at the lower tariff while maintaining viable financial conditions to recover the operating cost and to pay back the loan, and reach a certain level of FIRR.

State subsidy/grant will be necessary in about 50 percent of the total investment cost.

Other funding is recommended to have an interest rate not above 7 percent and preferably with a 10-year grace period.

4.9.4 Economic and Social Analysis

4.9.4.1 Economic Analysis

Regarding the economic valuation of the project, the most preferable approach would be the quantification of the economic benefits and costs. In many cases, however, many factors can not be quantified. The concept can be shown as follows.

Table 4.26 Concept of Economic Analysis

Category	Indicators	Improvement of Indicators	Economic Units	Economic Value
Health benefits	generally difficult to specify and quantify the effect.			
	(example) Number of water borne disease	(example) If the number decreases to 50 from 121 in 1997, Improvement number is 71	(example) Average yearly expenditure on health care and medical service per capita in 1996 is 109 litas	(example) 71*109*1.131 *1.084 (1996-1998) = 10,000litas
Environmental benefits	Pollution charge	Changes in pollution charge	-	litas.15,000 (2001) - 75,000 (1997) = litas. - 60,000
Local economic benefits-1	Real estate tax	-	-	-

Table 4.25 Projected Tariff to Achievo 5% FIRR (continued)

Category	Indicators	Improvement of Indicators	Economic Units	Economic Value
Local economic benefit-2	Regional I-O effects	Construction costs litas. 11.3 million	A multiplier by I-O table 2.0-3.0 (in case of Japan)	litas.11.3 * 2.5 = litas. 28.1 million
International relation	Economic effect	Economic Growth	Contribution to environmental standard improvement	Contribution to environmental standard improvement

4.9.4.2 Social Analysis

The social aspects of the project, in other words how the project will directly affect the lives of the people in the area, must be considered with care. Analysis will consider unique characteristics of the area in terms of the relative affluence of the people and their requirements/ desires in terms of the sanitation and income level.

According to the questionnaire survey, water and sewerage expenses to average monthly expenses in Birzai is 1.3 percent and it seems to be not higher than other areas considering the differences of the income level and the tariff level. It is said that the maximum limit of the ratio usually adopted for sewerage charges in developing countries is about 2 percent. GDP per capita in Lithuania is a level of middle development countries. The people can therefore afford to pay more than 2 percent. Increase of the tariff can be expected even though the people in Birzai do not want to pay sewerage charges according to the questionnaire survey. However, increase of the tariff should be discreet.

The average annual unemployment rate in Birzai is lower than other districts, but is still over 5 percent. Reduction of employees may be necessary in order to manage the company and to cover the costs besides increasing the tariff. It may be difficult for the company to reduce the number of staff members, but the priority should be given to efficient management.

4.10 IMPLEMENTATION PROGRAM

Implementation program of the proposed project will consist of the following stages:

- Detailed design
- Financial preparation
- Tendering
- Construction
- Commissioning

The schedule of each stage is assumed as shown in Figure 4.11.

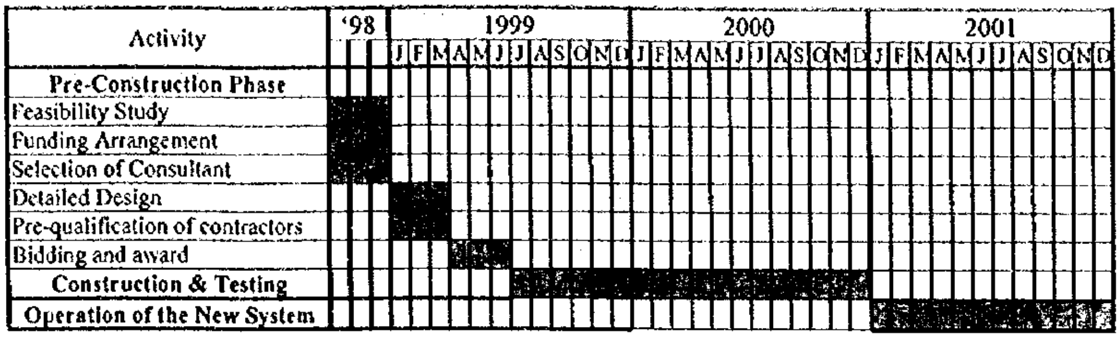


Figure 4.11 Implementation Schedule

4.11 RECOMMENDED ORGANIZATION AND MANAGEMENT OF THE WATER COMPANY

4.11.1 Recommended Organization

4.11.1.1 Changes in Organization

A recommended organization for the Water Company is presented in Figure 4.12.

4.11.1.2 Establishment of Clearer Business Units and Accounting Units of Water and Sewerage Services

The income of the company is generated only from the water supply and sewerage services. It is natural that many common costs are shared between the water department and sewerage department. Likewise, the controller, finance and administration costs should also be shared properly. Cost sharing ratios and a table (similar to that presented below) should be established.

4.11.1.3 Further Utilization of Part Time Workers and Outside Orders in the Future

The Water Company already utilizes part-time workers and outside services and many companies in foreign countries have been using part-time workers and soliciting services from outside firms for clerical workers, office cleaning, guards and meter reading, etc. These service industries will appear if not already in existence, as the society moves to a market oriented one. It is important to cut personnel costs by utilizing part-time work to a maximum, where possible.

4.11.2 Recommended Enforcement of Management

4.11.2.1 Intensification of personnel management

The number of staff members has been increasing as the coverage area has expanded. The Water Company is in the process of establishing an appropriate organization for efficient management. Now, the Water Company should focus on management of personnel and establishing an efficient organization for the immediate term. Consumers may have some complains about the increase of the tariff and the expense of excess personnel, based on the recent questionnaire survey. In order to raise the tariff to cover costs, the Water Company must make the effort to analyze itself thoroughly and show consumers efforts are made to reduce personnel costs.

4.11.2.2 Negotiation on the Coverage Area with Municipalities

It is clear that the expansion in service areas will decrease the efficiency of the Water Company and cause operational losses for the company. Expansion should be cautious and the Water Company should negotiate the sharing of costs with municipalities if the company has to include additional areas from the viewpoints of regional policy.

4.11.2.3 Integrated Management Information System

An integrated management information system should be installed to manage the company efficiently. A billing and collection control system, revenue accounting system, water and sewerage system monitoring and maintenance system, stock and supply control system, procurement control system, operation cost accounting system, assets control system and cash control system, settlement account system and budgeting system are recommended.

Monthly or quarterly assessment of the efficiency and achievement of goals should be performed for management review and control. Recommended information management system is shown in Figure 4.13.

4.11.3 Performance Assessment System

4.11.3.1 Goals and Assessments for Business Units

The company may not be familiar with the assessment system for business units. Private or self supporting companies should establish achievable goals at the start of each fiscal year. The achievement ratio (actual over planned) should be assessed every quarter or twice a year. The managers of the business units have responsibilities to meet the achievement ratio and staff members of the units share the responsibility when personnel performance is assessed. Companies also face many everyday difficulties and this kind of activity may seem to be unrealistic because the company is kept busy coping with immediate troubles. The Water Company is however an on-going concern, and this activity to reach goals is very important to solve long term problems systematically and understand the structure of management performance.

4.11.3.2 Written Goals and Performance Assessments for Staff Members by Personnel Meetings

All staff members should have clear goals every year and performance achievement ratios should be assessed once or twice a year. Goals are the same as those of the business units and could include personal goals for each staff member, i.e. better on-time work effort. These goals and assessments should be provided in written format. Personnel meetings between the director and every staff member should be held once or twice a year focusing on goals and assessments.

4.11.3.3 Incentives for Achievement of Goals

Based on the assessment activities, special incentives for achievement could be established. Special incentives include: 1) Bonus (in accordance with cost cutting amounts after improvement of loss), 2) Remuneration (in accordance with achievement ratio for the following year's remuneration), 3) Training (in accordance with achievement ratio for participating in training courses in special fields), and 4) Awards (in accordance with achievement ratio by giving a award from the Water Company), etc.

4.11.4 Other Issues in Organization and Management

4.11.4.1 Training and Education

Staff members should be given new information on new operation skills and technologies and therefore should participate in lectures and seminars to acquire this knowledge. Especially, staff members in the human resources unit in the business support department should take part in courses of personnel management and personnel assessment.

4.11.4.2 Continuation of Opinion Survey and Promotion of Understanding

Customers seem to always have complains concerning the tariff level and further increases in the tariff. The company should ask for the opinions of consumers in order to help decide upon tariff increases without regional political problems and to offset complains with improved service. It is important that the opinion surveys be continued and announcements be made to the public to overcome these comments for a better understanding of the tariff structure and the company management. A budget should include an amount for advertisement and publication.

Recommended program structure is shown in Figure 4.14.

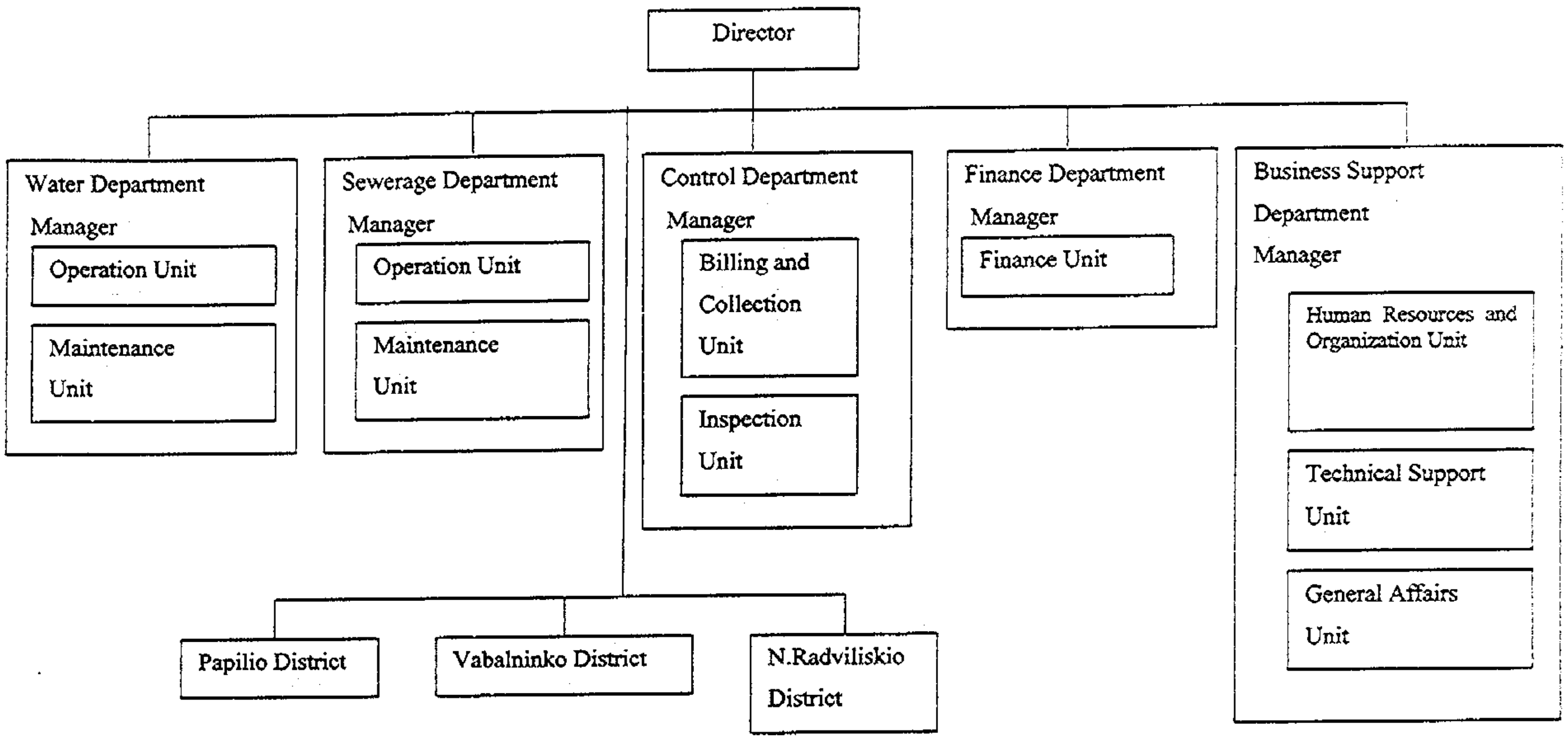


Figure 4.12 Recommended Organization for the Birzai Water Company

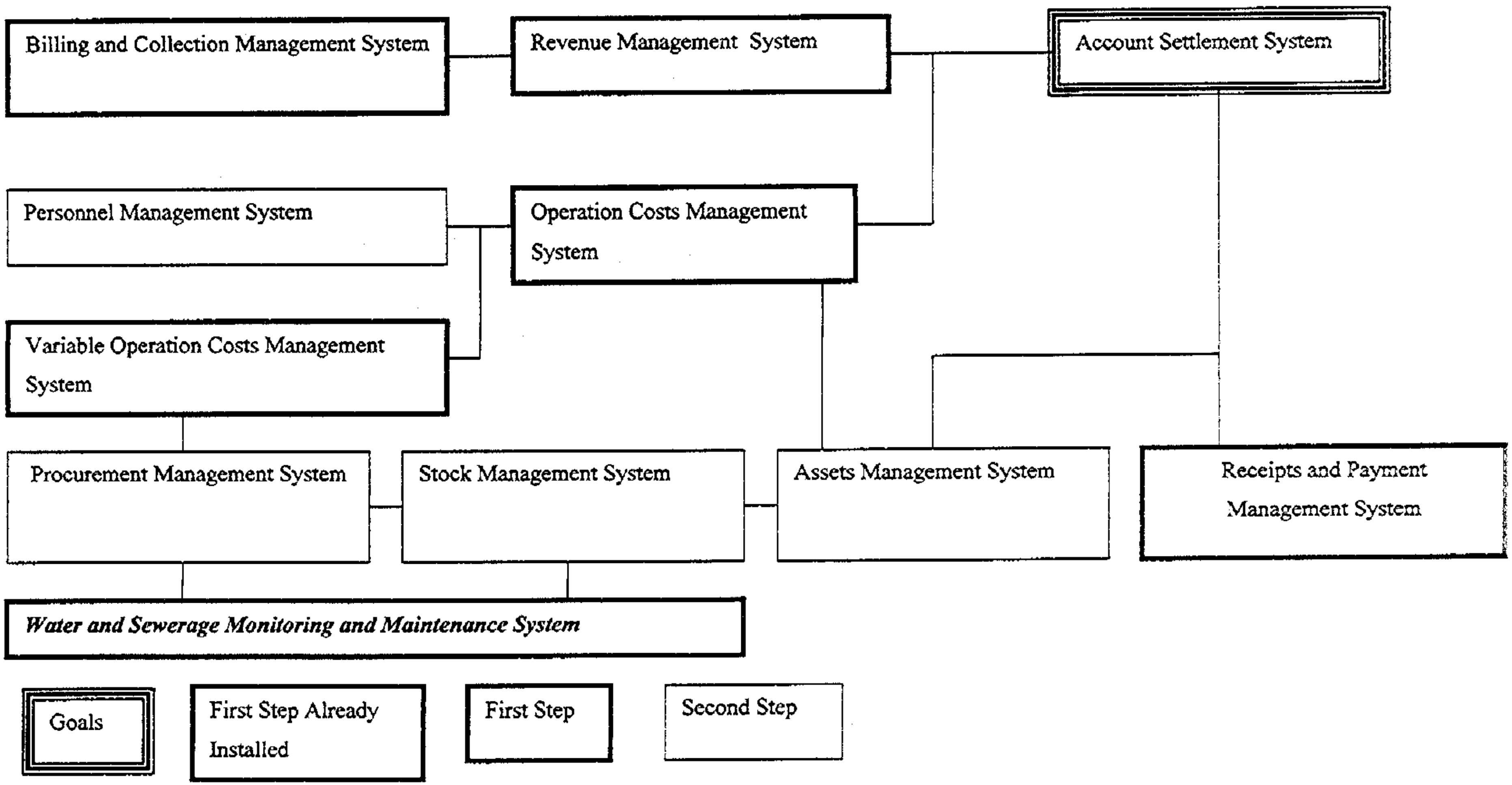


Figure 4.13 Recommended Information Management System

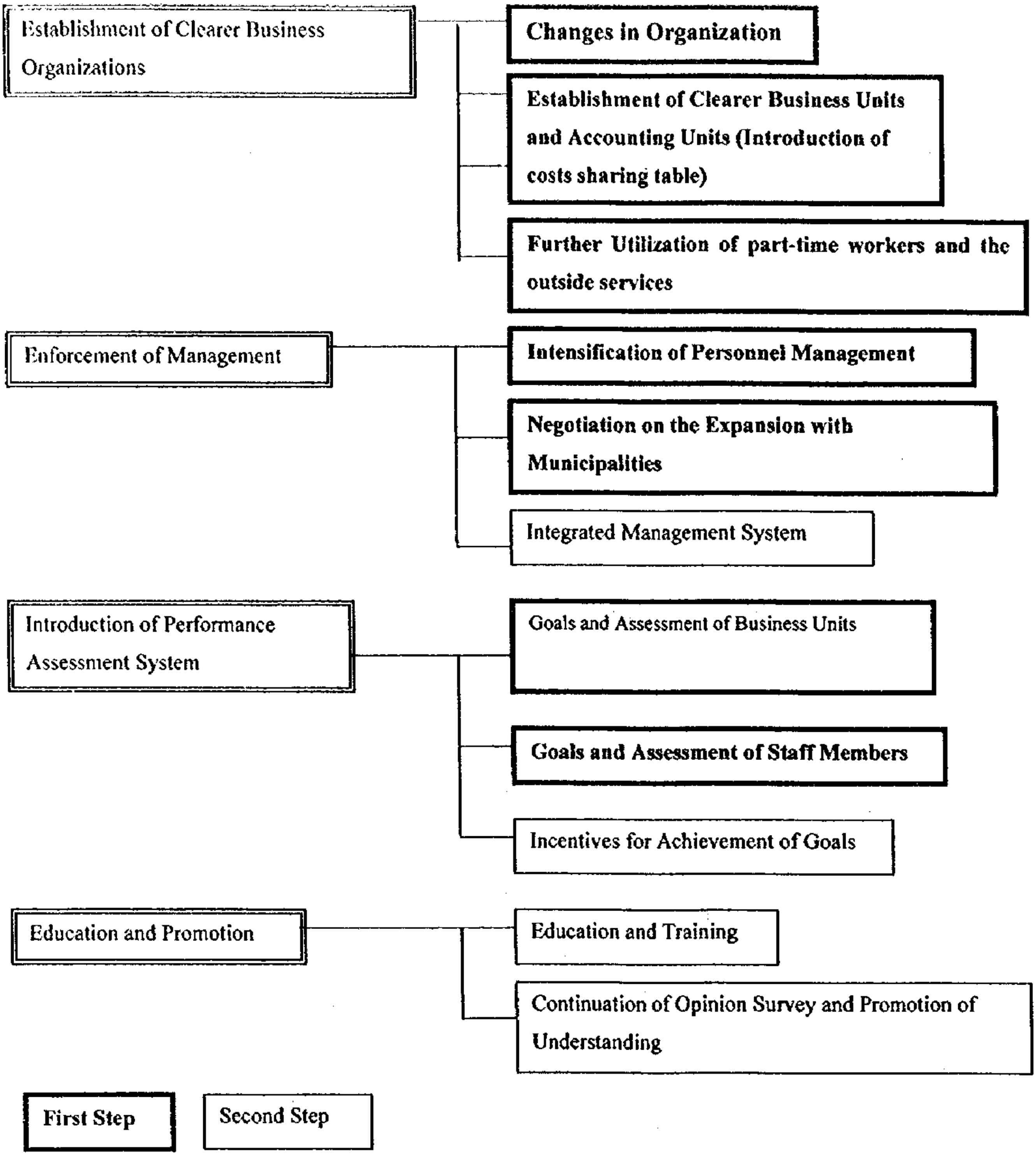


Figure 4.14 Recommended Program Structure for the Birzai Water Company

4.12 PROJECT EVALUATION

4.12.1 Rationale of the Project Implementation

Implementation of the proposed project is considered essential for protecting the water environment in the Birzai Region in particular for prevention of pollution and to maintain the quality of surface water and groundwater. Implementation of the project will further contribute to the preservation of the natural resources in the region.

4.12.2 Project Evaluation

4.12.2.1 Technical Evaluation

The project is feasible in terms of the technical aspects to meet the effluent standards set out by the Ministry of Environment. The proposed treatment method and treatment plant facilities are considered acceptable to the level of the technology and operating staff in Birzai and Lithuania.

4.12.2.2 Environmental Consideration

Implementation of the proposed project will not have a serious environmental impact either during the construction period or operation of the treatment plant.

4.12.2.3 Financial Evaluation

The financial analysis shows that the project is financial viable with a reasonable range of tariff setting and assumptions of financial sources in 50 percent of soft loan and 50 percent of state subsidy/grant.

4.12.2.4 Economic and Social Evaluation

The proposed project is expected to contribute to the upgrading of the local economic and social environment. Tourism is one of the major industries in the project area where Birzai is a local center of manufacturing. Improvement in the environment will be beneficial for the tourism development.

Living conditions of the residents will also be improved particularly when they have contact with the water of the lake and rivers through their amusement or hobby activities.

CHAPTER 5

SKUODAS TOWN SEWERAGE SYSTEM IMPROVEMENT PLAN

5 SKUODAS TOWN - SEWERAGE SYSTEM IMPROVEMENT PLAN

5.1 DESCRIPTION OF THE STUDY AREA

5.1.1 General

Skuodas is located 350 km northwest of Vilnius, 40 km from the Baltic Sea and only 2 km from the Lithuanian-Latvian border. Skuodas was first mentioned in history in 1253 as a part of territory occupied by Kuršiai called Ceklis. Skuodas received the first Catholic missionaries in 1567. Since then, through the 17th and 18th centuries, Skuodas has suffered from the wars and occupation of czarist Russia. Skuodas was the central district of the region during the occupation of the czarist Russia and during the Lithuanian independence period from 1918 to 1940. The present district territory was defined having an area of about 911 km^2 in 1950. The town of Skuodas (urban area) now occupies 596 ha and has a population of 8,970.

5.1.2 Natural Conditions

5.1.2.1 Topography

Skuodas is located on relatively flat land with an altitude between 16 to 30 m above sea level. Ground slopes gently downward from southeast to northwest. Residential areas in the town are located at higher elevations to the south and southwest.

5.1.2.2 Meteorology

Temperature and precipitation of Skuodas area are shown below:

Table 5.1 Temperature and Precipitation in Skuodas

Month	Temperature (°C)			Precipitation (mm)		
	Minimum	Average*1	Maximum	Minimum	Average	Maximum
January	-36.6	-	9.0	6	49	160
February	-35.5	-	14.0	2	33	97
March	-26.0	-	18.5	5	42	105
April	-16.3	-	25.0	2	39	111
May	-7.3	-	30.5	5	38	88
June	-1.7	-	34.1	5	65	138
July	3.1	-	32.8	11	75	166
August	0.0	-	33.0	5	97	302
September	-4.8	-	28.9	9	98	251
October	-10.4	-	23.5	7	85	265
November	-24.0	-	17.5	30	93	174
December	-29.8	-	11.2	9	68	150
				510*2	782	1,112*3

source: Meteorology Station

*1: average temperature of Skuodas is not available.

*2: minimum annual total precipitation (1976)

*3:: maximum annual total precipitation (1981)

5.1.2.3 Surface Waters

Skuodas has a 92 ha manmade lake just south of town. Two rivers flow through the town - the River Bartuva with the tributary Luoba River.

5.1.3 Socio-economic Conditions

5.1.3.1 Administrative Territory and Population

Skuodas Municipality has a total area of about 911 km^2 with the town of Skuodas (urban area) as the capital of the Municipality. The town of Skuodas has an area of 596 ha. The Municipality is governed by the council and mayor.

Population of Skuodas is shown in the table below:

Table 5.2 Population of Skuodas

Year	Municipality Population	Population in Skuodas Town (urban area)
1991	27,149	9,048
1992	27,389	9,130
1993	27,525	9,065
1994	27,731	9,074
1995	27,737	9,054
1996	27,770	9,039
1997	27,775	8,974

As shown above, the population of the town has been decreasing slightly while that of the municipality has been almost stable. There has been limited migration in and out of the municipality.

5.1.3.2 Economy

Commercial and Industry

The main industry in the Skuodas Municipality is agriculture similar to other local areas in Lithuania. In Skuodas town, there is only one milk factory producing dairy products.

Local Investment

There is no local investment program either of the government or of the private sector.

Employment

Statistics Department shows the unemployment in Skuodas Municipality as follows:

Table 5.3 Unemployment Rate in Skuodas

Year	Skuodas	Lithuania
1993	8.1%	4.4 %
1994	10.1%	3.8 %
1995	9.6%	6.1 %
1996	10.2%	7.1 %

Unemployment in Skuodas is high compared with the overall country's average figure due to the depression of the local economy.

5.1.3.3 Public Investment Program

As of the beginning of 1998, the sewerage system improvement project is the only program for Skuodas Municipality proposed in the Public Investment Program of the Government.

5.1.4 Land Use

5.1.4.1 Present Land Use

The present land use of the Skuodas Municipality as follows:

Residential	126.70 ha	Agricultural	55.31 ha
Commercial	91.90 ha	Military	0.13 ha
Industrial	10.45 ha	Parks	38.00 ha
Institutional	9.64 ha	Lake	92.00 ha
		Others	171.87 ha
		Total	596.00 ha

5.1.4.2 Development Plan for Future Land Use

Currently there is no definite plan to develop or expand the present urban area.

5.2 WATER COMPANY (VANDENYS)

5.2.1 History

Skuodas Water Company was established in April 1995 as a joint stock company from the former Klaipėda Water Supply Department. The Municipality owns all of the share capital of the Water Company.

5.2.2 Organizational Structure and Responsibility

In 1997, Skuodas Water Company had a total of 32 employees. Organization of the Water Company and the number of staff of each division are shown in Figure 5.1.

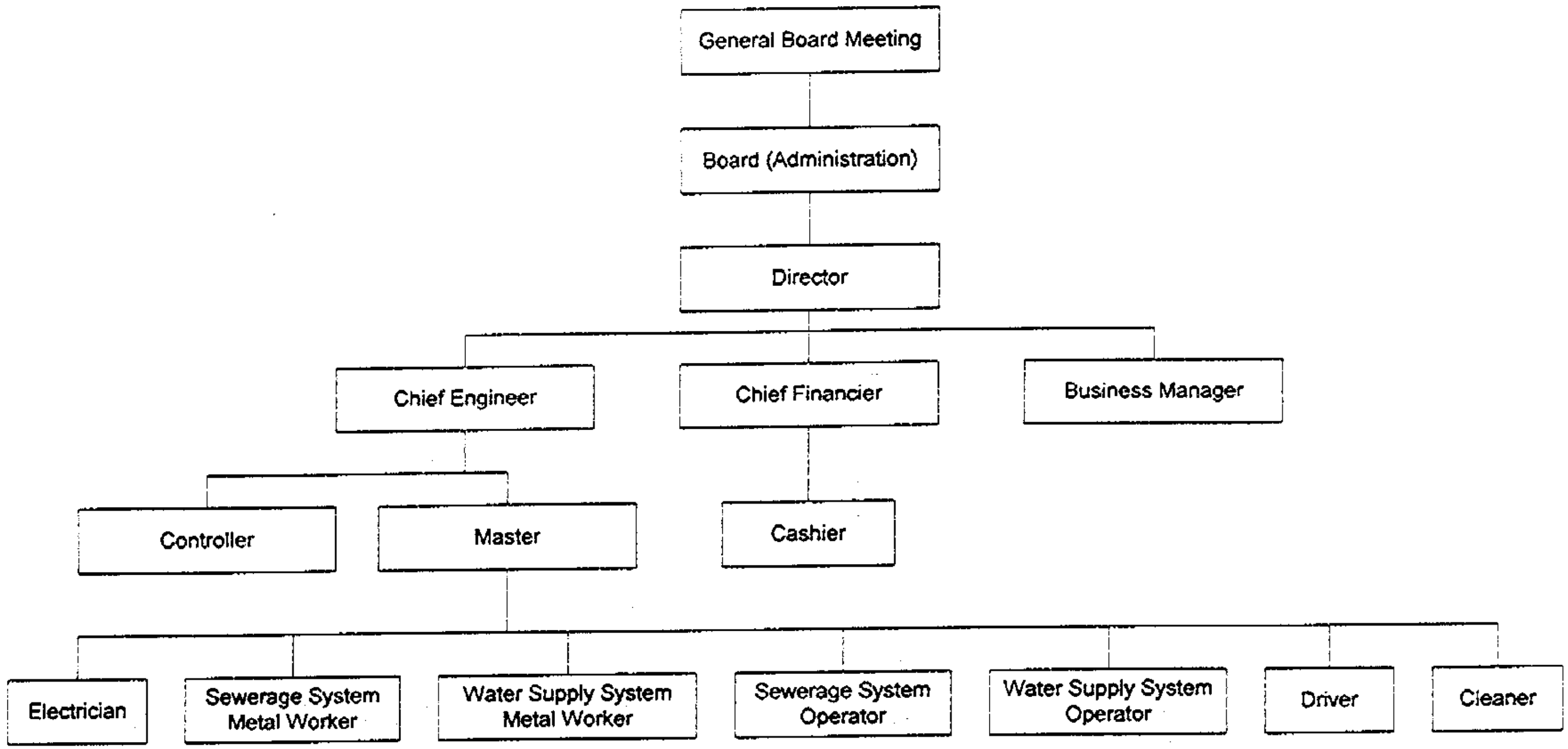


Figure 5.1 Organization of Skuodas Water Company

5.2.3 Service Area and Population Served

Populations served in 1996 and 1997 are tabulated as follows:

Table 5.4 Population Served -- Water Supply and Sewerage

Year	Water Supply	Sewerage
1996	7,200	6,695
1997	7,245	6,731

5.2.4 Tariff Structure

Tariffs for water supply and sewerage are set up as follows:

Table 5.5 Tariff Schedule

User Type	Water Supply	Sewerage
Residential use	2.00 Lt/m^3	1.80 Lt/m^3
Enterprise	2.00 Lt/m^3	1.80 Lt/m^3

5.2.5 Financial Performance

The Skuodas Water Company made losses both in 1996 and in 1997. Operating losses to sales, however, decreased from -6.5 percent in 1996 to -5.6 percent in 1997. Current losses to sales decreased from -11.8 percent in 1996 to -10.3 percent in 1997. Losses to sales improved a little but the ratio is still on the negative side.

5.3 EXISTING SEWERAGE SYSTEM

5.3.1 Existing Facilities

5.3.1.1 General

The sewerage system of Skuodas has been developed since the 1960's to collect, transfer and treat the sewage discharged in the town proper. The existing system consisting of pipelines, pump stations, and a treatment plant was completed in 1962. Currently, the existing system collects sewage totaling about 2,200 m^3/day. The layout of the existing sewerage system is presented in Figure 5.2.

5.3.1.2 Sewage Collection

The sewage collection system of Skuodas is a separate system in which only sewage is collected. Rainwater is drained into the rivers or the lake through open channels. The sewerage collection system consists of sewer pipelines and pump stations. The total length of sewers is 19,185 m with diameters ranging 100 to 500 mm.

5.3.1.3 Sewage Treatment

Existing Treatment Plant No.1

The plant was constructed in 1979 with a design capacity of 75 m^3/day. It receives sewage from Pump Stations No.1 and 3. At present, the plant receives about 600 m^3/day of sewage. The plant is therefore heavily overloaded. Layout of the existing treatment plant is presented in Figure 5.3.

Existing Treatment Plant No.2

The plant was constructed and owned by Land Reclamation Company with a design capacity of 340 m^3/day. It was then transferred to the Water Company in 1995. It receives sewage from Pump Station No.2. At present, the plant receives about 70 m^3/day of sewage. This amount is much less than the design capacity. Layout of the treatment plant No.2 is shown in Figure 5.4.

5.3.1.4 Sludge Disposal

Existing Treatment Plant No.1

Sludge stored in the bottom compartment of the Imhoff Tank is removed by suction equipment from the manhole adjacent to the tank. Sludge settled in the contact chamber is taken away once every week or two. Removal of the sludge from the Imhoff tank is carried out about once a month using a tanker. At present, sludge is disposed to agricultural land as a normal practice in Lithuania.

Existing Treatment Plant No.2

After being dried in the drying bed, sludge is removed and disposed to agricultural land. As the incoming sewage amount is low, the sludge production is also minimal.

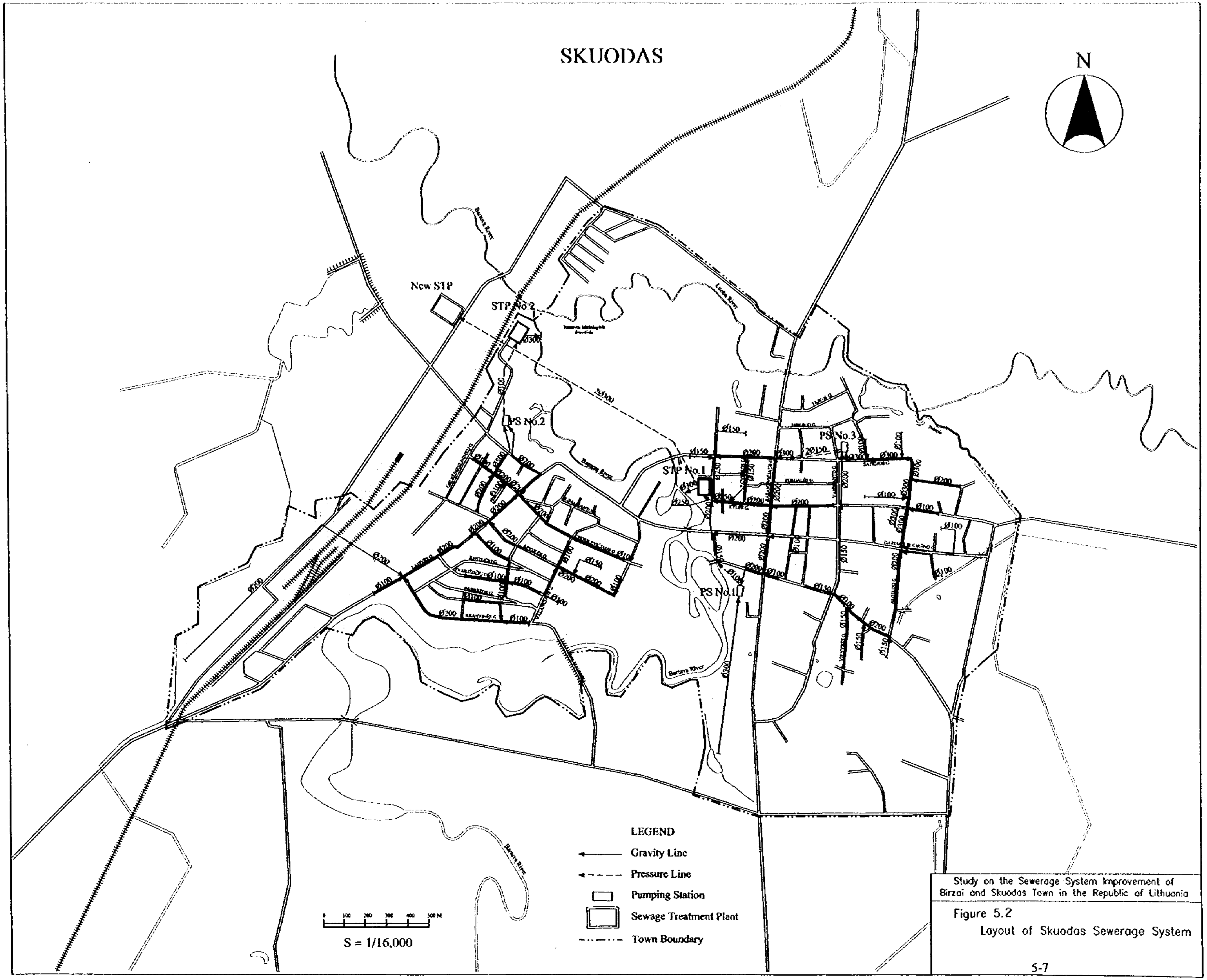
5.3.1.5 Discharge of Effluent from the Treatment Plant

The two existing treatment plants discharge effluent to the Bartuva River at the closest point from each plant site. Discharge point of the No.1 plant is located just downstream of the bridge connecting the old town and new town.

5.3.2 Characteristics of Sewage and Plant Performance

5.3.2.1 Existing Data of Sewage Characteristics

The Water Company conducts a water sampling and quality analysis of the influent and effluent of the treatment plant at Palanga Water Company once a month. Wastewater of the milk factory and other commercial entities are also taken and analyzed at Klaipėda Environmental Department four times a year.



Study on the Sewerage System Improvement of Birzai and Skuodas Town in the Republic of Lithuania

Figure 5.2
Layout of Skuodas Sewerage System

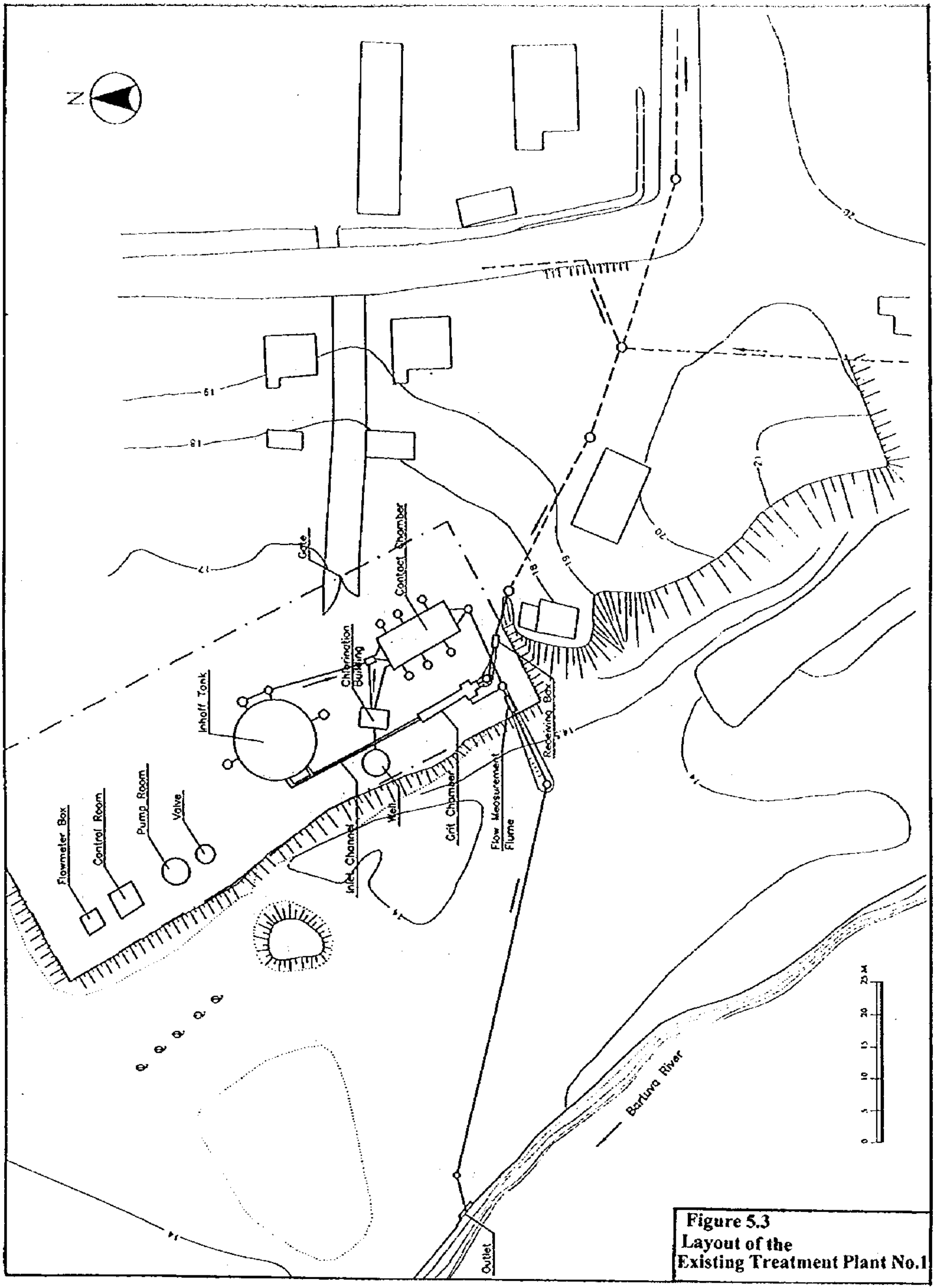
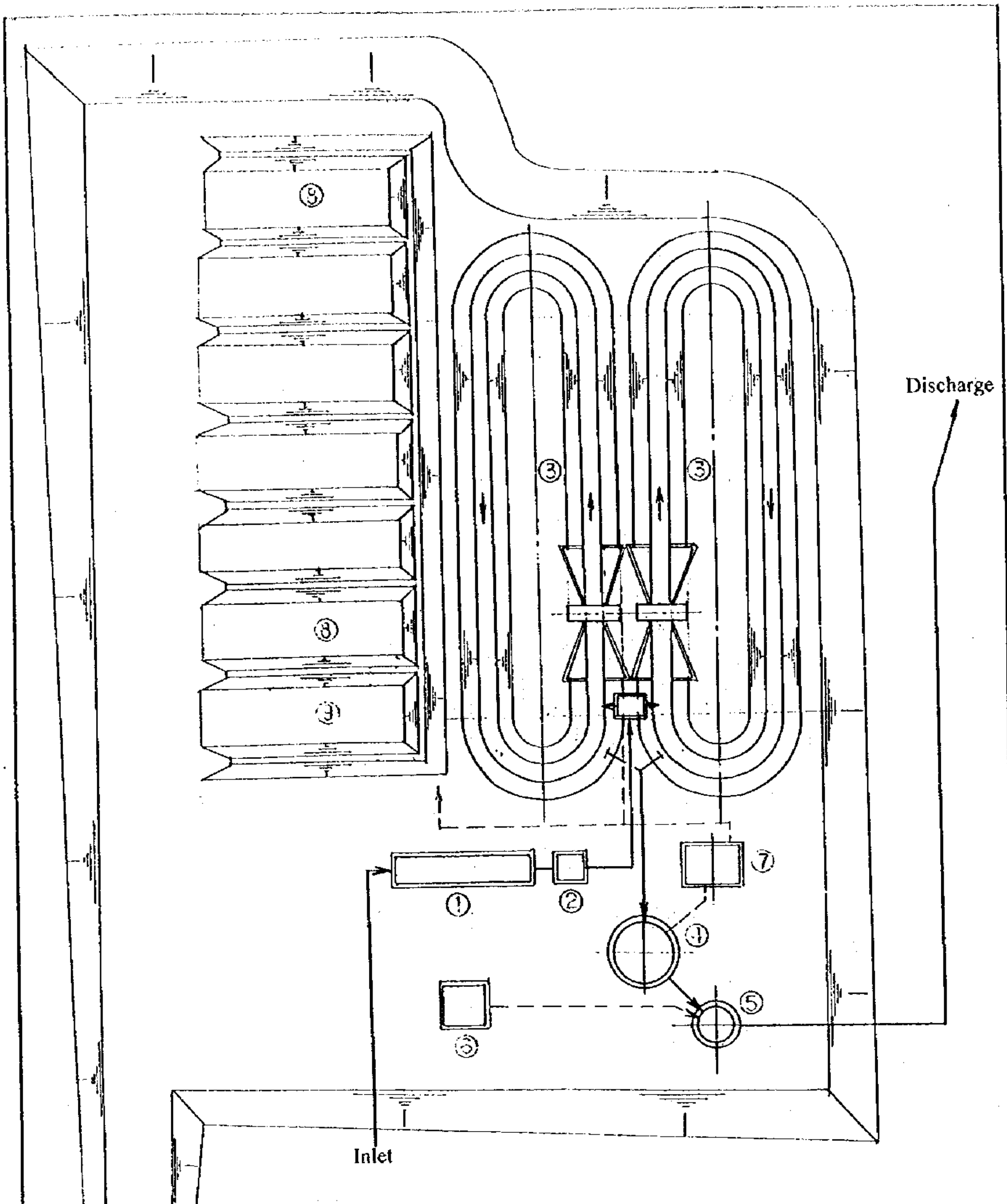


Figure 5.3
Layout of the Existing Treatment Plant No.1



① Grit Chamber
② Flow Measurement Box
③ Oxidation Ditch
④ Sedimentation Tank
⑤ Chlorination Tank
⑥ Chlorine Disolving Tank
⑦ Sludge Pit
⑧ Sludge Drying Bed
⑨ Sand Lagoon

Figure 5.4
Layout of the Existing Treatment Plant No.2

5.3.2.2 Performance of the Existing Treatment Plants

Existing Treatment Plant No.1

As shown in the water quality data, the existing treatment plant No.1 does not satisfy the national effluent standards referred to in Section 3.5.1.1. The summary of the influent and effluent are shown below.

Table 5.6 Summary of Performance of the Treatment Plant No.1

	BOD_7		COD_{Mn}		SS		Total-N		Total-P		Detergent		Oil	
	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.
Maximum	973	307	222	97	428	144	142	67	16.0	8.6	9.1	3.0	1.40	1.30
Minimum	181	94	54	42	110	73	40	30	6.9	5.9	0.8	0.0	0.00	0.00
Average	459	225	112	65	244	116	67	49	10.5	7.2	3.5	1.4	0.37	0.25
Effluent Standard	20 (ave.) 30 (max.)		100 (ave.) 150 (max.)		30 (ave.) 45 (max.)		NA		NA		2		1	
Average of Removal Ratio	45%		37%		47%		23%		27%		47%		34%	

Effluent standard: for <10,000 p.e.

BOD_7 and suspended solid far exceed the maximum values set in the standards while the COD, detergent, and oil are within the acceptable range of the standards. This failure is easily explained from the design of the treatment process that is only physical treatment.

Existing Treatment Plant No.2

The existing treatment plant No.2 is being operated with less load than designed. Summary of the treatment performance is shown in table below.

Table 5.7 Summary of Performance of the Treatment Plant No.2

	BOD_7		COD_{Mn}		SS		Total-N		Total-P		Detergent		Oil	
	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.
Maximum	2128	212	376	22	1853	29	81	31	16	7.2	9.6	1	1.1	0.45
Minimum	26	6.3	12	9	33	7	15	6.4	1.2	1.2	0.11	0	0.08	0
Average	316	32	92	15	361	16	36	21	7	3	3	0	0	0
Effluent Standard	20 (ave.) 30 (max.)		100 (ave.) 150 (max.)		30 (ave.) 45 (max.)		NA		NA		2		1	
Average of Removal Ratio	68%		62%		82%		34%		41%		78%		61%	

Effluent standard: for <10,000 p.e.

Suspended solid and COD are well below the effluent standards. BOD7 does not comply with the standards. Considering that the plant is under-loaded, the aeration practice in the oxidation ditch is not satisfactory while the suspended solid and organic substances contained in the suspended solid are removed in sedimentation process.

5.3.2.3 Industrial Wastewater

In Skuodas, there is only one factory that is a milk company. In 1997, this factory consumed 40 m^3/day of water on daily average basis. The total water consumption of this facility is only 6 percent of the total water consumption.

5.3.2.4 Results of the Water Sampling and Water Quality Analysis

The JICA Study Team conducted a water sampling and water quality analysis to supplement the data for sewage. Water samples were taken at the points and with a frequency as follows:

Raw Sewage

From the inlet channel of the treatment plant No.1 and No.2

4 days x 13 samples/day (every 2 hours for 24 hours)

= 52 samples

As well as water sampling, flow rate measurements were conducted at each sampling time. Samples were analyzed at the Vikta Laboratory in Vilnius. Results of the sampling are summarized in Table 5.8.

Table 5.8 Results of Water Quality Analysis

item	unit	sampling date			
		Jul 28-29	Aug 06-07	Aug 13-14	Aug 20-21
Sewage Flow	m^3/day	1,253	1,001	1,476	526
SS	mg/l	490	362	157	209
BOD_7	mg/l	519	273	198	296
Soluble BOD_7	mg/l	201	94	78	165
COD	mg/l	957	757	396	589
Total-N	mg/l	57	65	55	58
Total-P	mg/l	11.8	9.7	13.6	9.3

Note: Concentrations are calculated as a weighted average of the concentrations and flow-rates of the 12 samples taken every 2 hours during 24 hours. Details are presented in Appendix 4.

5.4 EXISTING CONSTRAINTS FOR SEWERAGE SYSTEM

5.4.1 Technical Aspects

5.4.1.1 Collection system

Improvement in pump operation and flow regulation will be recommended to achieve a proper hydraulic loading to the treatment plant. The degree of flow regulation will be dependent on the flexibility of the treatment process. Design of most treatment plants normally incorporates a peak flow factor 2 to 3, and the degree of flow regulation may not be therefore as severe.

5.4.1.2 Sewage treatment plant

Existing Treatment Plant No.1

The Water Company has already decided to abandon this plant. The Water Company constructed a pump station at this treatment plant, and dual transmission pipelines to transfer the incoming sewage to the proposed treatment plant site at the western suburb of the town.

Existing Treatment Plant No.2

The failure of this plant in terms of BOD removal is likely resulted from absence of sludge recycle. Presently, liquid is recycled by pumping from the bottom of the sedimentation tank to the oxidation ditch. The liquid however does not contain solids so that MLSS (Mixed Liquor Suspended Solid) in the oxidation ditch cannot reach the optimum level, that is normally above 3,000 mg/l. Further, because of the insufficient mixing in the ditch, suspended solid seems to be settling in the ditch channel rather than in the sedimentation tank. The ditch therefore works as a sedimentation tank. If the oxidation ditch and sedimentation tank work normally, the recycled liquid must contain more condensed sludge.

5.4.1.3 Industrial wastewater

From the data of water quality and water consumption, BOD_7 load of the wastewater from the milk company's factory is estimated at about 6 percent of the total load incoming to the treatment plant. Impact of the organic load in the industrial wastewater is therefore considered insignificant.

5.4.2 Managerial Aspects

5.4.2.1 Collecting Incorrect Charges from Collective Housing

It has been reported that some residents tried to manipulate meter reading to reduce the consumption by use of a magnet or by releasing water in so small amount that it cannot be detected by the presently used water meters. This problem may however be more or less overcome by replacing the existing meters with ones sensitive enough to detect small flow.

Some flats do not have meters. If so, they pay charges based on a norm, which is a standard usage of volume for those who have no meters. The company has not been collecting the correct charges from residents in collective housing because residents not having meters use more water than the norm. It is estimated that the company has been losing 15 to 20 percent of the correct charge.

5.4.2.2 Self-Declaration System

Individual house consumers who have water meters record the water usage from the meters every month by themselves and fill out the form in the subscription booklets. Based on a random sampling check by the company last year, 15 users out of 200 samples were found not paying the correct charges, accounting for some 7.5 percent of the sample. Since the number of residents is small, the percentage of people who do not pay the correct amount may be substantial.

5.4.2.3 Short of Periodic Performance Evaluations

The company is supposed to check all detached houses twice a year, but actually it chooses approximately 200 houses at random out of 514 houses and checks whether users have paid the proper amounts from April to July. About 15 customers were found to have not paid the proper amounts last year. If the company had checked all detached houses, about 40 users might have been found not paying the correct amount.

5.4.2.4 Lack of integrated management information system

A computerized information system is to be installed in a controller room to manage billing and collection of the water and sewerage fees, as of June 1998. There are no more information systems planned for any of the management functions. Lack of information systems causes inefficiency in gathering correct information and inability to provide speedy action to meet problems.

5.4.2.5 Process of a Self Supporting Management System

The Water Company manages itself on a self-supporting accounting system and also follows policies for tariff collection for the municipality. The Water Company actually does not have an autonomous management.

5.4.2.6 Process of Rationalization

Operation costs increased by 12.7 percent, the same as the increase in sales, although inflation (CPI) was 8.9 percent in 1997. The number of employees still remains at the same level as when the company started operation. As previously stated, the company must check the incorrect revenues and the number of staff members in charge of checking may not be enough. On the other hand, there may be some redundancies in other business units, mainly technical units.

5.4.3 Financial Aspects

5.4.3.1 Unclear Business Units

Financial analysis is based on sharing common indirect costs between the water and sewerage divisions. The sharing system for wages and salaries of staff members who work for both the water and sewerage divisions and some other common operational expenses has not been clearly defined.

5.4.3.2 Increase of Sales and Operating Costs

The company increased sales by 13.6 percent in 1997, mainly due to the tariff increase. The tariff increased by 25 percent for water supply and by 32 percent for sewerage system for residential users and by 9 percent for other users. The costs also increased by almost the same degree. The operation continued at a loss with only a 2.1 percent improvement in the operating loss level and 3.1 percent decrease in the net loss level.

5.4.3.3 Decrease of Usage

The volume of sales in 1997 decreased by more than 12 percent due primarily to the tariff increase. It is not clear whether the volume will again decrease. According to the questionnaire survey, 50 percent of those questioned do not want to pay the charge for sewerage service and 24 percent answered that the sewerage charge should be paid by the government. The tariff for sewerage in Skuodas is already at a relatively high level.

5.4.3.4 Long Collection Period and Delayed Payment

There is a major delay of more than three months in bill collection from the hot water and heating company in Skuodas. Some public institutions have also delayed payment because of a shortage of funds. Some ten percent of customers have delayed payment.

5.5 FUTURE DEMAND FOR THE SEWERAGE SYSTEM

5.5.1 Design Year

The design year is set at the year 2010. This target is 12 years from the planning stage and considered suitable for the design horizon of the new facilities.

5.5.2 Service Area

The entire urban area is set as the service area for the proposed improvement plan of the sewerage system.

5.5.3 Planned Population and Sewage Amount

5.5.3.1 Population

Future population of the urban area of Skuodas is projected using the growth ratio applied in the projection of country's population prepared by the Department of Statistics as presented in Section 2.3.3.2. Of three medium scenarios, the medium-3 scenario (medium-high) is adopted since it has a slight increase in the country's population and is on the safe side in the projection of the amount of sewage. Yearly growth rates of population are tabulated as follows:

Table 5.9 **Yearly Population Growth Rate and Population**

Year	Country Total (% / year)	Urban Area (% / year)	Urban Population
1997-2000	-0.02%	-0.05%	8,970
2001	0.09%	0.24%	8,992
2002	0.16%	0.32%	9,020
2003	0.19%	0.34%	9,051
2004	0.21%	0.37%	9,084
2005	0.24%	0.39%	9,119
2006	0.27%	0.42%	9,158
2007	0.26%	0.39%	9,193
2008	0.24%	0.35%	9,226
2009	0.23%	0.32%	9,255
2010	0.23%	0.31%	9,284

Calculated from Population Projections of Lithuania (Medium-3), Department of Statistics, 1998

5.5.3.2 Service Ratio and Population Served

As of 1997, the service ratio of water supply and sewerage expressed as population is 80.7 percent and 75.0 percent, respectively. The Water Company expects these figures to increase to 90 percent by 2010. Therefore, the population served by the water supply and sewerage would increase as calculated in table below.

Table 5.10 Projection of Population Served

Year	Water Supply		Sewerage	
	population served	service ratio	population served	service ratio
1997	7,245	80.7 %	6,731	75.0 %
2000	7,176	80 %	6,997	78 %
2005	7,752	85 %	7,660	84 %
2010	8,355	90 %	8,355	90 %

Population served = urban population x service ratio

5.5.3.3 Sewage Quantity

Domestic Sewage

From the water supply data in 1996 and 1997, per capita water consumption was calculated at 84 l/cap/day (1996) and 73 l/cap/day (1997). It may be interpreted that the drop in consumption from 1996 to 1997 is because of the increase in water tariff.

This unit consumption is very small for an urban area that would normally be more than 120 l/cap/day. The Water Company explained that the people of Skuodas are saving the cost of water after the tariff was increased. The Study Team also conducted an interview with residents in the town and found that people are living with minimum use of water even for bathing and washing.

The Water Company anticipates that the people's attitude of saving water would continue and that the per capita consumption in 2010 will likely not be higher than 110 l/cap/day.

For the projection of water consumption, increase in per capita consumption is therefore set at 80 and 110 l/cap/day for 2000 and 2010, respectively. It is assumed that 90 percent of the amount consumed is discharged into the sewers.

Table 5.11 Projection of Domestic Sewage

Year	Population served	Per capita water consumption (l/cap/day)	Domestic Sewage (m^3/day)
1997	6,731	73	477
2000	6,997	80	517
2005	7,660	95	663
2010	8,355	110	827

domestic sewage = population served x per capita consumption x 90%

Wastewater of Industry and Hospital

According to the manager of the milk company, there is no plan to expand the factory facility at present or in the near future. It is therefore assumed that the amount of industrial wastewater will maintain the present level (40 m^3/day) until 2010. For the purpose of projection, 50 m^3/day is adopted.

Wastewater of the hospital has records of 70 to 100 m^3/day in 1996 and 1997. The amount of discharge is normally dependent on the occupation ration of the hospital. For the projection, 100 m^3/day is adopted as a higher figure for industrial contribution of wastewater.

Infiltration

From the flow measurements conducted in this study, amount of the infiltration is estimated at approximately 30 percent of the average water consumption although it varies.

For the projection for the year 2010, ratio of the infiltration is set at 30 percent of the other flow.

Projected Amount of Sewage

From the discussion above, the amount of sewage is calculated as follows:

Table 5.12 Projection of Amount of Sewage (Daily Average Flow)

unit: m^3/day

Year	Domestic sewage	Industrial wastewater	Hospital wastewater	Infiltration	Total Amount
Total Service Area (New Town and Old Town)					
2000	517	50	100	200	867
2005	663	50	100	244	1,057
2010	827	50	100	293	1,270
Service Area of Existing Plant No.1 (New Town)					
2000	450	50	100	180	781
2005	586	50	100	220	956
2010	740	50	100	267	1,156
Service Area of Existing Plant No.2 (Old Town)					
2000	53	0	0	16	88
2005	69	0	0	21	114
2010	88	0	0	26	145

In the projection above, the amount of infiltration increases while the sewer network may not be substantially expanded. This can be possibly explained by the fact that the increase in service connections and aging of the sewer pipes could lead to an increase in infiltration.

5.6 SEWERAGE SYSTEM IMPROVEMENT PLAN

5.6.1 Design Flow

Design flows are summarized in Table 5.13.

Table 5.13 Design Flow

	Flowrate			
	m^3/day	m^3/hour	m^3/min	m^3/sec
Daily average flow (Q_{da})	1,270	52.9	0.88	0.015
Daily maximum flow(Q_{dm})	1,600	66.7	1.11	0.019
Peak hourly flow (Q_{hp})	3,200	133.3	2.22	0.037

$Q_{dm} = Q_{da} \times 1.35$

$Q_{hp} = Q_{dm} \times 2.0$

5.6.2 Characteristics of Sewage and Population Equivalent

With the projected sewage and pollution load, characteristics of sewage are calculated using the per capita unit load (70 g-BOD_7/cap/day) as follows:

Table5.14 **Calculated BOD Load and Concentration**

	Amount (m^3/day)	Population served	BOD_7 Load		BOD_7 (mg/l)	Population equivalent
			unit load (g/cap/day)	Total Load (kg/day)		
Domestic Sewage	827	8,355	70	585	707	8,355
Industrial Wastewater	50			125	2,500	1,786
Infiltration	293			-	-	-
Total	1,270			710	560	10,141

Note: Pollution load in the hospital wastewater is considered to be included in the domestic sewage.

Using the population equivalent calculated above, other pollution loads are calculated as follows:

Table5.15 Calculated SS, Total-N and Total-P Loads and Concentrations

	SS	Total-N	Total-P
population equivalent	10,141	10,141	10,141
unit load (g/p.e./day)	70	12	2.7
total load (kg/day)	710	147	27
concentration (mg/l)	560	96	22

5.6.3 Effluent Standards to be Applied

The effluent standard shall be as follows:

Table 5.16 Effluent Standard for Sewage Treatment

Pollutants	Permissible Concentration (mg/l)	
	Average annual concentration (Cave)	Maximum instantaneous concentration (Cmax)
BOD_7 (>10,000 PE)	15	25
COD (≥10,000 PE)	75	120
Total-P (≥10,000 PE)	1.5	2.5
Total-N (10,000 – 100,000 PE)	20	35
Suspended Solid (<100,000 PE)	30	45

5.6.4 Improvement Plan for the Collection System

As the existing pump system has sufficient pumping capacity, the new pump station to be completed at the Treatment Plant No.1 may have only two pump units. The other pump stations will need improvement of flow regulation.

5.6.5 Improvement Plan for the Treatment System

5.6.5.1 Location of the New Treatment Plant

In the previous development plan for constructing the new treatment plant, a site outside the town boundary was proposed. Dual 300 mm pressure pipelines have been laid from the existing plant No.1 to the new treatment plant site. This site is located outside the town boundary and the transmission pipeline has been laid to this site. This site is recommended due to both the effective use of the past investment and the environmental advantage.

5.6.5.2 Alternative Sewage Treatment Method

Two systems below are evaluated as they are normally used for small-scale system:

1. Oxidation ditch (OD)
2. Sequencing batch reactor (SBR)

Comparison of the two alternative treatment methods is summarized in Table 5.17. From this comparison, the oxidation ditch method is proposed by the reasons as follows:

- Daily operation and maintenance is extremely easy. Actually, no operation is required, as the major equipment will run continuously 24 hours a day.
- Because the circulating flow in the ditch continuously dilutes the influent, variations in the incoming loads (i.e. varying concentration of BOD) will be absorbed so that the biological reaction takes place in relatively stable condition.
- In case of mechanical trouble of the equipment (aerator, mixer or sludge collector), sedimentation tank will still work as a fail-safe device that will at least remove suspended solid and BOD contained in the solid. In case of SBR, any mechanical failure of a decanter will be fatal as the effluent is extracted by movement of the decanter.

Table 5.17 Comparison of Alternative Treatment Methods

Item	Oxidation Ditch (OD)	Sequencing Batch Reactor (SBR)
Flow in Reaction Tank	circulating plug flow	complete mixing
System Component	oxidation ditch (2,900m^3) sedimentation tank	flow regulation tank (450 m^3) batch reactor (3,920m^3)
Equipment	aerator/mixer sludge collector sludge pump	aerator/mixer decanter sludge pump
Operation	**24 hours continuous operation** aeration/mixing sludge recycling	**cyclic batch operation** sequential operation of inflow, aeration/mixing, settling, decanting
Manual operation	**easy** on-off operation of the equipment is not required in daily work all equipment run 24 hours a day without adjustment	**manual operation is actually impossible** sequential operation needs timer-set or computerized operation program
Daily maintenance	**actually none**	**scum removal checking sludge volume**
Against the variations in the incoming load	**flexible** no special adjustment required as variations are absorbed in the circulating flow	**flexible but needs high level of expertise** for adjusting the sequence

Table 5.17 Comparison of Alternative Treatment Methods (continued)

Item	Oxidation Ditch (OD)	Sequencing Batch Reactor (SBR)
Stability of biological reaction	**stable** due to continuous operation and large absorbing capacity against the load variations.	**less stable** biological reaction in each batch occurs under varied load conditions.
Required Land Area	1.8 ha	1.8 ha
Construction Cost	Lt. 6.62 million	Lt. 6.00 million
Operation Cost	Lt.136,000/year	Lt.161,000/year
Total Cost in NPV*	8,130,000	7,875,000

* NPV: Net Present Value for 25 years operation, discount rate = 5 %/year

5.6.5.3 Sludge Treatment and Disposal

For dewatering, mechanical dewatering equipment is proposed to reduce the water content in sludge below 85 percent. Decanter (centrifuge) type dewatering is selected as a suitable method due to its high efficiency and ease of operation. Prior to dewatering, a gravity thickening process will be provided to reduce the water content from about 99.4 percent to 98 percent.

5.6.6 Conclusion and Recommendation

As discussed in the Sections above, the recommended improvement plan for the Skuodas Sewerage System is summarized as follows:

1. Sewage Collection System Improvement
   - Expansion of sewers will not be required except for small branch pipes for new house connections;
   - As the Water Company has purchased the pump units for the new pump station at the existing treatment plant No.1, installation of these units will be required. Number of pump to be installed is two;
2. Sewage Treatment System
   - Abandon the two existing treatment plants;
   - Construct a new treatment plant at the previously proposed site outside the town boundary;
   - New treatment plant will employ an oxidation ditch method for sewage treatment;
   - Treated effluent will be discharged into the Bartuva River;
   - Excess sludge will be treated by gravity thickening and mechanical dewatering using a centrifuge;
   - Dewatered sludge is treated by composting and stored for agricultural use; and
   - For emergency in case the dewatering machine breaks down, a sludge lagoon having one month storage will be provided.

5.7 PRELIMINARY DESIGN OF THE PROPOSED FACILITIES

5.7.1 General

A preliminary design of the proposed facilities for a sewage treatment plant is presented based on the recommendation described in the previous section. Detailed preliminary drawings are presented in Volume III Supporting Report.

5.7.2 Required Land Area of the Sewage Treatment Plant

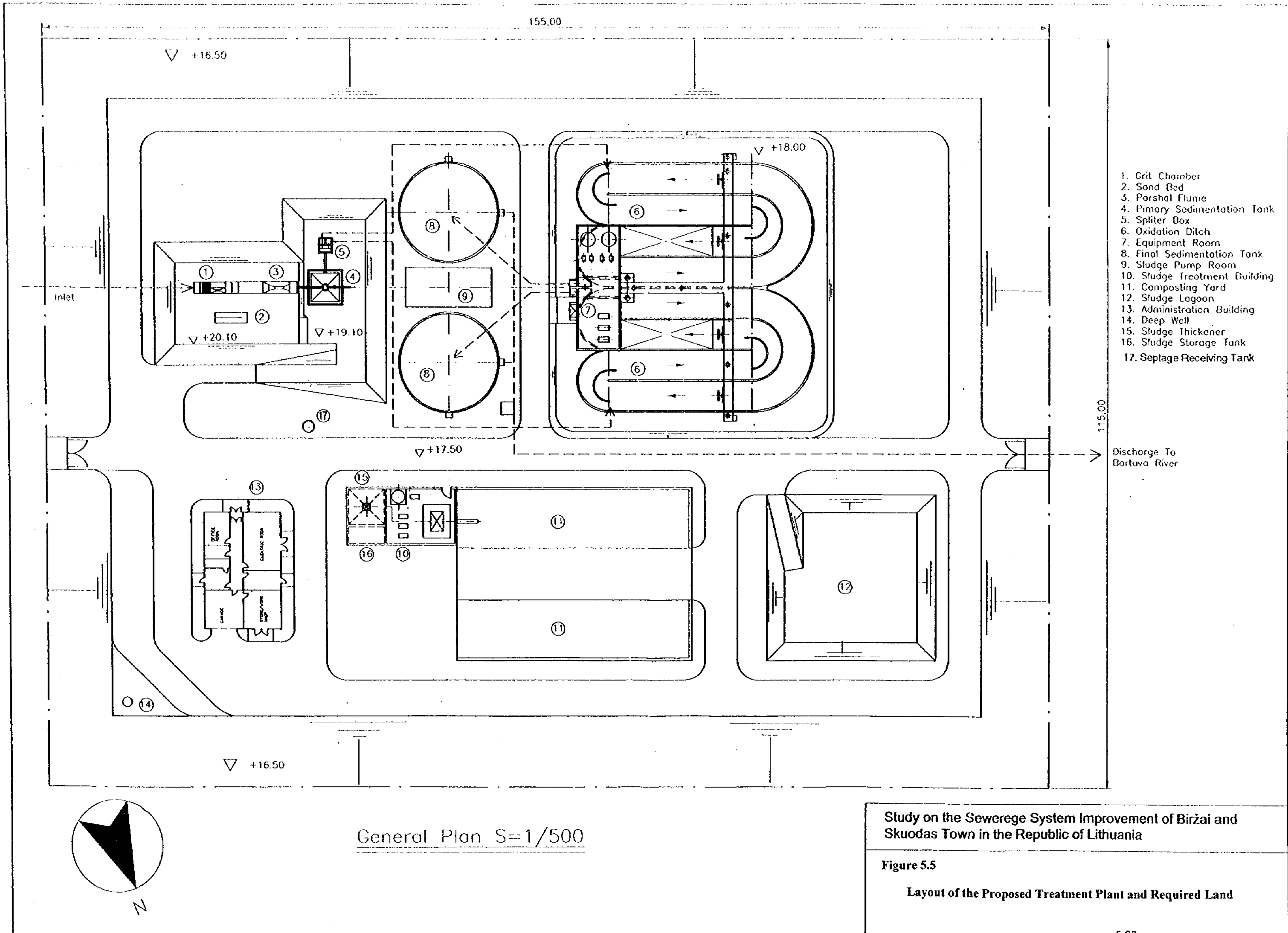
For the proposed treatment facility, the required land area is estimated at 1.8 ha as shown in the plant layout in Figure 5.5. This land area is smaller than the previously proposed scheme that required a land area of approximately 3.9 ha.

5.7.3 Design Basis

Design basis of the treatment plant is summarized below:

Table 5.18 Design Basis of the Treatment Plant

Item	Value		Remark
Design Flow			
Daily Average Flow	1,270 m^3/day		used for computing sludge amount and operation cost
Daily Maximum Flow	1,600 m^3/day		used for design of biological reaction tank and sludge treatment
Hourly Peak Flow	3,200 m^3/day		used for design of pipelines, inlet works and sedimentation tank
Influent Quality			BOD_5 is used for design of the biological treatment system.
BOD_7	560 mg/l		
BOD_5	490 mg/l		
COD	1,000 mg/l		
Total-N	70 mg/l		
Total-P	12 mg/l		
Suspended solid	500 mg/l		
Design Effluent Quality	Cave.	Cmax.	LAND 10-96
BOD_7	15 mg/l	25 mg/l	
BOD_5	13 mg/l	22 mg/l	
COD	75 mg/l	120 mg/l	
Total-N	20 mg/l	35 mg/l	
Total-P	1.5 mg/l	2.5 mg/l	
Suspended solid	30 mg/l	45 mg/l	
Minimum temperature	7°C		



General Plan S=1/500

Study on the Sewerege System Improvement of Biržai and Skuodas Town in the Republic of Lithuania

Figure 5.5

Layout of the Proposed Treatment Plant and Required Land

5.7.4 Sewage Treatment Plant

The proposed treatment plant consists of the facilities as follows (details of the preliminary design is presented in Main Report).

- Grit Chamber
- Parshall Flume
- Primary Sedimentation Tank
- Biological Reaction Tank (Oxidation Ditch)
- Final Sedimentation Tank
- Sludge Pumps
- Sludge Thickener
- Sludge Storage Tank
- Sludge Dewatering Machine
- Sludge Composting Yard
- Sludge Lagoon
- Chemical Feeding Facility
- Septage Receiving Tank
- Administration Building
- Sludge Building
- Sludge Pump Building

5.8 CONSTRUCTION PLAN AND PROJECT COST ESTIMATES

5.8.1 Construction Schedule

An overall construction schedule for Skuodas is presented in Figure 5.6 and is 13 months in length including the demolition of the existing treatment plant. Also included is a facilities construction schedule, shown in Figure 5.7 which shows the schedule for the various components of the work.

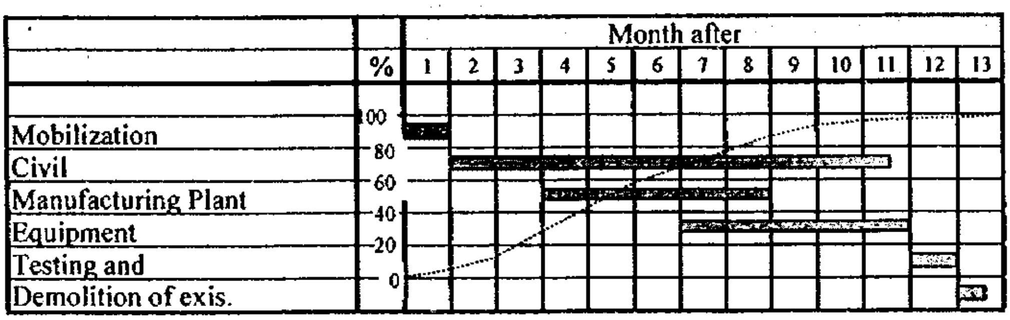


Figure 5.6 Overall Construction Schedule

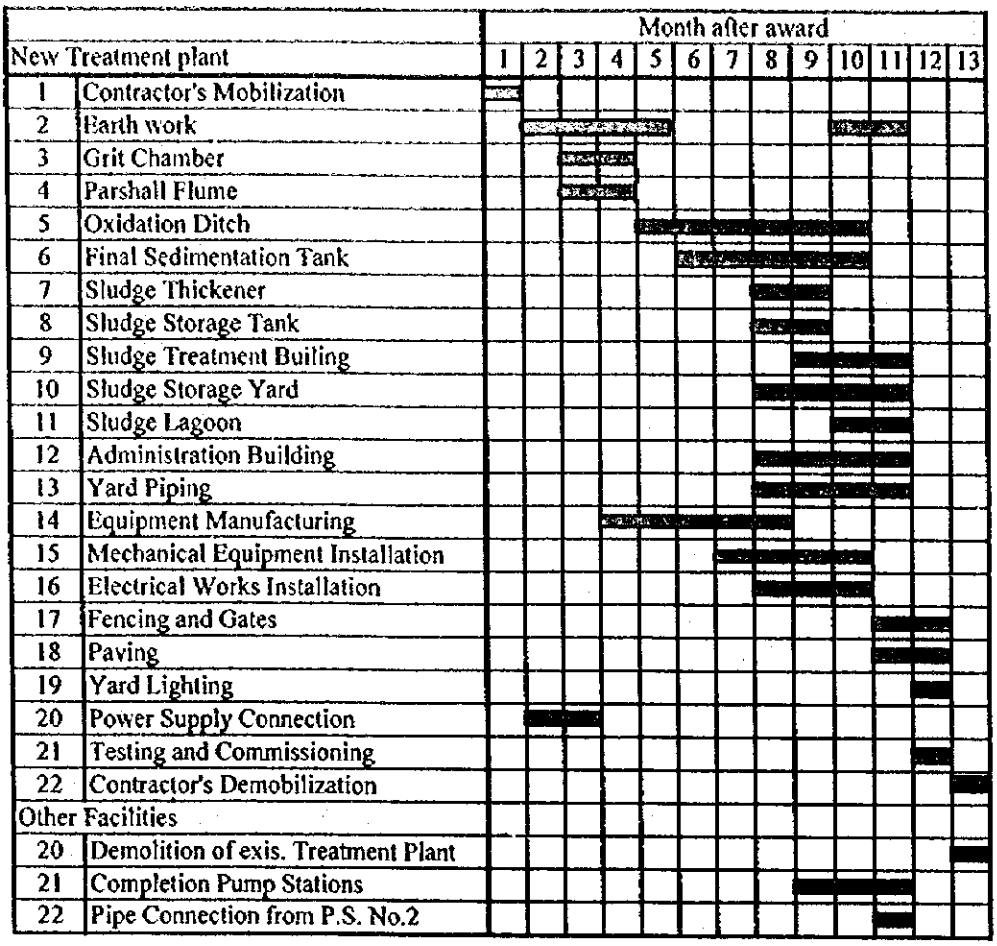


Figure 5.7 Facilities Construction Schedules

5.8.2 Construction Supervision

To obtain a quality product on time, within the construction funding limit, it is necessary to have full time inspection/supervision of the contractor's activities. It is proposed that the design engineer also perform the inspection/supervision work to avoid design/construction disputes and for a better, more prompt interpretation of the contract documents. A construction resident manager should report directly to the Ministry of the Environment and the local Water Company on the physical and financial status of the work. Under the resident manager would be several resident inspectors and technicians. Specialists in other disciplines would be available as needed from the design engineer's office.

5.8.3 Construction Costs

The construction costs for the project components are shown in Table 5.19.

Table 5.19 Construction Costs for the Skuodas Project

		Amount (Litas)	% of F/C	F/C	L/C
Construction Cost					
Treatment Plant					
1 Structures		2,809,748			
1 Grit chamber	11,729		50%	5,864	5,864
2 Parshall flume	2,380		50%	1,190	1,190
3 Primary sedimentation tank	42,867		50%	21,434	21,434
4 Splitter box	8,288		50%	4,144	4,144
5 Oxidation ditch	942,620		50%	471,310	471,310
6 Sludge pump house	101,673		50%	50,836	50,836
7 Final sedimentation tank	341,362		50%	170,681	170,681
8 Sludge thickener	61,352		50%	30,676	30,676
9 Sludge storage tank	28,143		50%	14,072	14,072
10 Sludge treatment building	159,960		30%	79,980	79,980
11 Sludge composting yard	721,447		50%	360,724	360,724
12 Administration building	287,928		30%	86,378	201,550
13 Miscellaneous structures	100,000		30%	30,000	70,000
2 Earth Work		26,648	30%	7,994	18,654
3 In-plant Piping		122,364	70%	85,655	36,709
4 Site Development		437,764	30%	131,329	306,435
5 Plant Equipment and Electrical Works		2,895,000	80%	2,316,000	579,000
6 Water Supply Facility		80,000	70%	56,000	24,000
7 Landscaping		30,000	30%	9,000	21,000
8 Procurement of vehicles and maintenance equipment		300,000	80%	240,000	60,000
Pipeline Connection to the existing Pressure Mains					
DIP dia.100 mm, L = 100 m		10,000	80%	8,000	2,000
Demolition of the Existing Treatment Plants		30,000	30%	9,000	21,000
Construction Cost Total		6,742,000		4,190,267	2,551,257

Demolition involves removing all above ground structures and buildings from the existing treatment plant site, removing all slabs at grade, cracking of the bottoms of below grade structures so water will not accumulate, filling all below grade tanks and basins with earth or sand to ground level, salvage of all reusable equipment or material, removal of off-site services (electricity, telephone, water and heat/hot water), and removing and disposing of all trash, unused equipment and materials, and waste from the site.

5.8.4 Operational Cost

Operational costs for the project include operation and maintenance labor, social insurance, and other related costs. Since these costs occur on an annual basis, the present worth has been calculated and added to construction to obtain the project cost.

Other operational costs include outside services for electrical energy, laboratory analysis, spare parts and small tools, telephone and telemetry, fuel supply and chemical supplies. It is planned to use plant personnel for trash, screenings and grit disposal at a nearby landfill. Dried sludge will be given to local farmers for a soil conditioner and low level fertilizer. A potable water supply system by deep wells would be included in the plant design. Sewerage service would also be included in the plant design through a sewer and drain system, pumping to the plant inlet. A heat and hot water system would also be provided by an in-plant system for the Administration Building. A plant water system would provide treated effluent for washdown, toilet flushing, fire protection, water seals and chemical solution water as applicable. Operational costs for Skuodas is shown in Table 5.20.

Table 5.20 Operational Costs

Item	Cost/Year (Lt./year)
Power - 100 kW	36,000
Chemicals	52,000
Fuel and Spare Parts/Tools	48,000
TOTAL	136,000

5.8.5 Other Costs

Other costs shown in Table 5.21 include land acquisition and engineering costs for Skuodas. Land acquisition is not required at Skuodas as the municipality owns the proposed treatment plant site and the easements necessary for pipeline construction and maintenance. An easement along the effluent discharge pipe to the canal which empties into the Bartuva River must be obtained prior to construction to avoid claims from the contractor for delay. Usually, the Ministry or Water Company will obtain any required land for the project and costs for repayment are not included in any project grants or loans.

Table 5.21 Other Costs

Item	Cost (Lts)
Land/Easements	-
Engineering	
Final Design	269,680
Construction Supervision	404,520
TOTAL	674,200

5.8.6 Project Cost

The final project cost for Skuodas is shown in Table 5.22. This cost includes the construction cost and other cost, including land acquisition, administration and engineering costs and a project contingency of five percent. The total project cost is 7.7 million Litas or 1.95 million US dollars.

Table 5.22 Project Cost

unit: 1000 litas

Item	Foreign Cost	Local Cost	Total Cost
Construction Cost	4,190	2,551	6,742
Other Costs	472	202	674
Contingency (5%)	230	140	371
TOTAL PROJECT COST	4,892	2,894	7,787

5.9 FINANCIAL, ECONOMIC AND SOCIAL ANALYSIS

5.9.1 Financial Analysis

5.9.1.1 Basis of Financial Analysis

A financial model has been constructed, focusing on cash-flow forecasting, to conduct a financial analysis of the proposed project. Tariff required to recover the operating and too pay back the loan (both the principal and the interests) has been projected in comparison with financing sources with different costs.

5.9.1.2 Financial Resources Assumed

Main financial resources are assumed as follows:

State Grant/Subsidy

Considering the difficult financial situation of both the Skuodas Water Company and Skuodas municipality, some subsidy from the state budget may be necessary for financing the project implementation. The state subsidy is assumed at 50 percent of the total investment cost.

Loan from foreign official aid or commercial institutions

With the tight limitation of the tariff increasing, the feasibility of the Project will depend largely on the loan with the lowest cost and most favorable conditions (grace period, e.g.)

Cash reserve of the Skuodas Water Company is assumed not to be used for the initial investment, nor to be reinvested in any additional investments during the project period.

5.9.1.3 Effects of Inflation

Inflation will have a great effect on the project. In the analysis, all the costs, except for the depreciation, maintenance and spare parts, taxes, and preparation for bad receivables are assumed to rise at the inflation rates assumed.

All the initial investment costs have been calculated in the future price, using the inflation rates assumed.

Considering that the project will probably use a fixed interest rate loan, and also from the view point of real value for tariffs, the moderate (lower) rates are assumed as follows:

Period	Inflation Rate (see Section 2.3.4.2)
1998	6.1%
1999	5.9%
2000 and after	5.0%

The effects of variation in the inflation rates for the project have been simulated and analyzed in the Sensitivity Analysis.

5.9.1.4 Project Period

In the financial analysis, a 25-year period is used with following considerations:

- In accordance with the financial conditions of foreign aids, pay-back period is more or less 25-year including a grace period.
- This period seems reasonable from the facility life and depreciation period of the equipment.

5.9.2 Financial Performance

Using the financial model, the financial performance has been projected and analyzed, focusing the FIRR and tariff required to recover the total cost.

5.9.2.1 Financial Internal Rate of Return (FIRR)

FIRR was calculated for the case of the leveraged finance with a state subsidy/grant for 50 percent of the investment cost and with some soft loan (lower cost) financing for the balance of 50 percent. Conditions for the soft loan is assumed at an interest rate of 7 percent and 10-year grace period such as Nordic Investment Bank (NIB) loan. Tariff is set at 2.27Lt/m^3 in the beginning. FIRR is then calculated at 5 percent, the hurdle rate which is considered by some official institutions as a benchmark for public projects.

5.9.2.2 Cost Recovery

In the model case using the leveraged finance (state grant 50 percent plus low cost loan 50 percent) as assumed above, the tariff level at the beginning for cost recovery is to be predicted at 2.24Lt/m^3. This means that from that tariff at the beginning of the operation and through 25-year operation, the project will just recover all the operation cost and pay back the loan (both the principal and interest).

To maintain the sustainable management, some plus FIRR should be assumed. If the benchmark of 5 percent FIRR should be applied, the sustainable tariff is predicted at about 2.27Lt/m^3.

This is 26.1 percent higher than the current tariff (1.80Lt/m^3).

5.9.2.3 Sensitivity Analysis

The result shows if the project use the loan with an interest cost of 7.0 percent ,then the tariff should be set at 2.27 Lt/m^3 to achieve 5 percent FIRR (and positive NPV using discount rate of 5 percent).

The result also shows that the interest cost has a effect on the initial tariff. The lower the interest rate is, the lower the tariff can be assumed. If the initial tariff be raised to the level about 2.27Lt, then the model shows the financing with interest cost of 5 percent will bring an high FIRR and NPV (with discount rate of 5 percent), and the financing with interest cost of 9 percent will bring an negative FIRR and NPV (it means the total project will lose more than 1 million litas at the present value using the discount rate of 5 percent, during the 25-year term).

It shows the different interest cost will have effect on the tariff, from the beginning to the end of the repayment period as follow:

Tariff (Lt/m^3) predicted in different interest costs are presented below:

Table 5.23 Projected Tariff to Achieve 5% FIRR

Interest Rate of Loan (%)	Tariff (Lt/m^3)		
	First Year	10th year	25th year
5	2.12	2.83	4.55
7	2.27	3.02	4.86
9	2.42	3.22	5.18

5.9.3 Conclusions and Recommendations

Through the use of the financial model, the financial feasibility has been analyzed; the tariff required to recover the all cost have been predicted; and the sensitivity of the tariff and FIRR to the variance of some important factors have been studied.

As a conclusion of the financial analysis, the following recommendations are proposed.

(1) Tariff Structure

- Tariff should be set not only to recover the operating cost, but also to pay back the loan (both the principal and the interests).
- In setting the tariff, a certain level of the positive FIRR should be fully considered, in order to maintain a sustainable management of the Water Company.
- The bench marking of 5 percent of FIRR should be a standard for the project.

- If finance can be arranged for 50 percent from the state subsidy/grant and for 50 percent from the loan at the cost below the level of 7 percent, the required tariff is predicted at the 2.27 Lt/m^3 in the first year. It should then increase once every two years during the first 4-year period, and once every 3 years for the remaining period of the project, both by 10 percent.
- The above predicted tariff may be affordable to the users for the reasons as follows:
  - Compared with the current level of the tariff, the predicted tariff will increase in 8.1 percent per year next 3 years.
  - Increase in tariff is considered modest during the whole repayment period that is 10 percent in every three years, while inflation rates is 5 percent every year. This is equal to 15.7 percent every three years.
  - Percentage of expense due to the sewage tariff in the family income will be maintained at the current level or rather improved (or decreased) if the family income is to catch up the inflation.

(2) Selection of Funding Source

With tariff limited within the acceptable level, selection criteria for funding source is recommended as follows:

- Tariff of Skuodas is already at the top (highest) level in the country.
- Economic development, family income and municipality budget is not expected to increase quickly.

As a result, feasibility of the project will largely depend on utilizing the loan with low cost and other favorable conditions. Grace period is also important for the project, considering the heavy financial burden in operation during the first ten years.

A funding source should be selected so that the project will be operated at the lower tariff while maintaining viable financial conditions to recover the total cost and reach a certain level of FIRR.

State subsidy/grant will be necessary in about 50 percent of the total investment cost.

Other funding is recommended to have an interest rate not above 7 percent and preferably with a 10-year grace period.

5.9.4 Economic and Social Analysis

5.9.4.1 Economic Analysis

Regarding the economic valuation of the project, the most preferable approach would be the quantification of the economic benefits and costs. In many cases, however, there are many factors which can not be quantified. The concept can be shown as follows.

Table 5.24 Concept of Economic Analysis

Category	Indicators	Improvement of Indicators	Economic Units	Economic value (1998 price)
Health benefits	Generally speaking, it is difficult to specify and quantify the effect.			
	(example) Number of skin disease	(example) If the number decreases to the level of 1000 from 1381 in 1997, Improvement number is 381	(example) Average yearly expenditure on health care and medical service per capita in 1996 is 109litas	(example) 381*109*1.131 *1.084 (1996-1998) = 51,000litas
Environment benefits	Pollution charge	The company will be able to pay adequate pollution charges from 0 to 4300 in 2002. Improvement is 4300	None	4,300 litas/year /(1.061*1.059* 1.05**2) =3,000 litas
Local economic benefits-1	Real estate tax	From 4000litas in 1997 to 8000litas in 2002 Increase of 4000litas	None	4,000 litas/year /(1.061*1.059* 1.05**2) =about 3,000 litas
Local economic benefit-2	Regional Input Output effects	Construction costs litas 6.66 million	A multiplier by I-O table 2.0-3.0 (in case of Japan)	6.66 million * 2.5 =16.7 million litas
International relation	Economic effect	Economic Growth	Contribution to environmental standard improvement	Contribution to environmental standard improvement

5.9.4.2 Social Analysis

The social aspects of the project, in other words how the project will directly affect the lives of the people in the area, must be considered with care. Analysis will consider unique characteristics of the area in terms of the relative affluence of the people and their requirements/desires in terms of the sanitation and income level.

According to the questionnaire survey, water and sewerage expenses to average monthly expenses in Skuodas is 2.2 percent and it seems to be higher than other areas considering the differences of the income level and the tariff level. Increase of the tariff should be discreet.

The average annual unemployment rate in Skuodas is higher than other districts. Reduction of employees may be necessary in order to manage the company and to cover the costs besides increasing the tariff. It may be difficult for the Water Company to reduce the number of staff members. The priority should however be given to efficient management.

5.10 IMPLEMENTATION PROGRAM

Implementation program of the proposed project will consist of the following stages:

- Detailed design
- Financial preparation
- Tendering
- Construction
- Commissioning

The schedule of each stage is assumed as shown in the figure below:

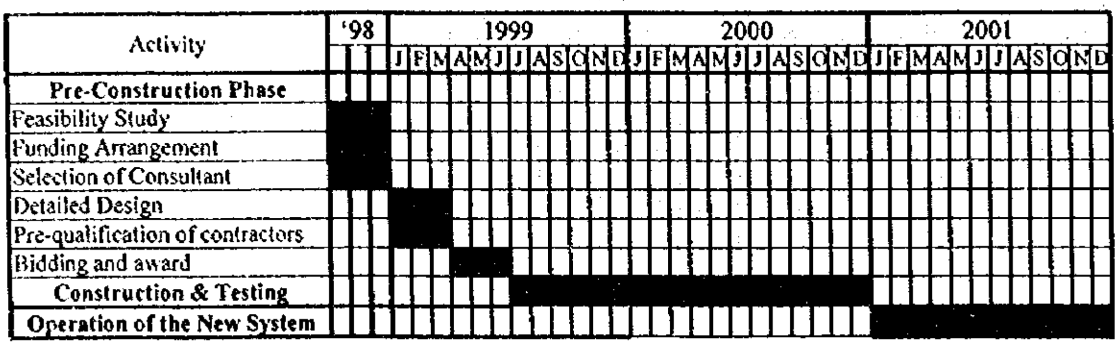


Figure 5.8 Implementation Schedule

5.11 RECOMMENDED ORGANIZATION AND MANAGEMENT OF THE WATER COMPANY

5.11.1 Recommended Organization

5.11.1.1 Reduction of Staff Members or Fixing Staff Levels

The Water Company has increased the tariff substantially over the past several years and the level is high in comparison to other companies. Consumers may have some legitimate complains on the increase in tariff and the high cost of service based on the questionnaire survey. In order to raise the tariff further to cover costs, the company has to make every effort to thoroughly review itself and show the consumers the serious efforts, being made to reduce costs. Two employees now operating the present sewage treatment plant can be eliminated once the new project is in operation. The number of employees should be fixed or reduced further even though water and wastewater treatment usage increases in the future. The increases can be managed through personnel movement from other departments or units.

5.11.1.2 Adjustment of Organization for Billing and Collection

The function of a controller in charge of billing and collection of fees will become more important in the future after installation of the new project and increases in usage of the services. Billing and collection of the fees is similar to the sales department of general private companies.

The Water Company, however, is not large enough to have a separate sales department. A controller department should be established and the number of controllers be increased by transferring engineering staff members. This function should be controlled by the director of the company. Recommended organization of the Water Company is shown in Figure 5.9.

5.11.1.3 Establishment of Clearer Business Units of Water and Sewerage Service

The income of the Water Company is only from charges for water supply and wastewater collection and treatment. It is natural that all common costs should be shared between the water supply department and the sewerage department. Administration costs and backup costs should be shared properly. Cost sharing ratios and a table for cost sharing should be established.

5.11.1.4 Introduction of part-time workers and the use of outside services in the future

Many companies in other countries have been using part-time workers and purchasing services outside the company for clerical workers, office cleaning, guards and janitorial services, etc. These service industries will appear as the society moves to market-oriented one. It is possible to cut personnel costs by introducing a part-time work system.

5.11.2 Recommended Enforcement of Management

5.11.2.1 Task Force Team for checking declarations

The Water Company should establish a task force team for checking the declarations of all consumers from spring to autumn.

5.11.2.2 Integrated Management Information System

An integrated management information system should be installed to manage the Water Company more efficiently. A billing and collection control system, revenue accounting system, water and sewerage monitoring and maintenance system, stock and supply control system, procuring control system, operation costs accounting system, assets controlling system and cash controlling system, settlement accounting system and a budgeting system are recommended to be included in the information system.

Recommended information management system is presented in Figure 5.10.

5.11.2.3 Join the Water Company Association

The Lithuanian Water Company Association consists of water companies and related private companies such as engineering technical and consulting companies and provides the members with information on dealing with technical and managerial problems. The association holds seminars for these subjects and joining the association would benefit the company in its self-evaluation process.

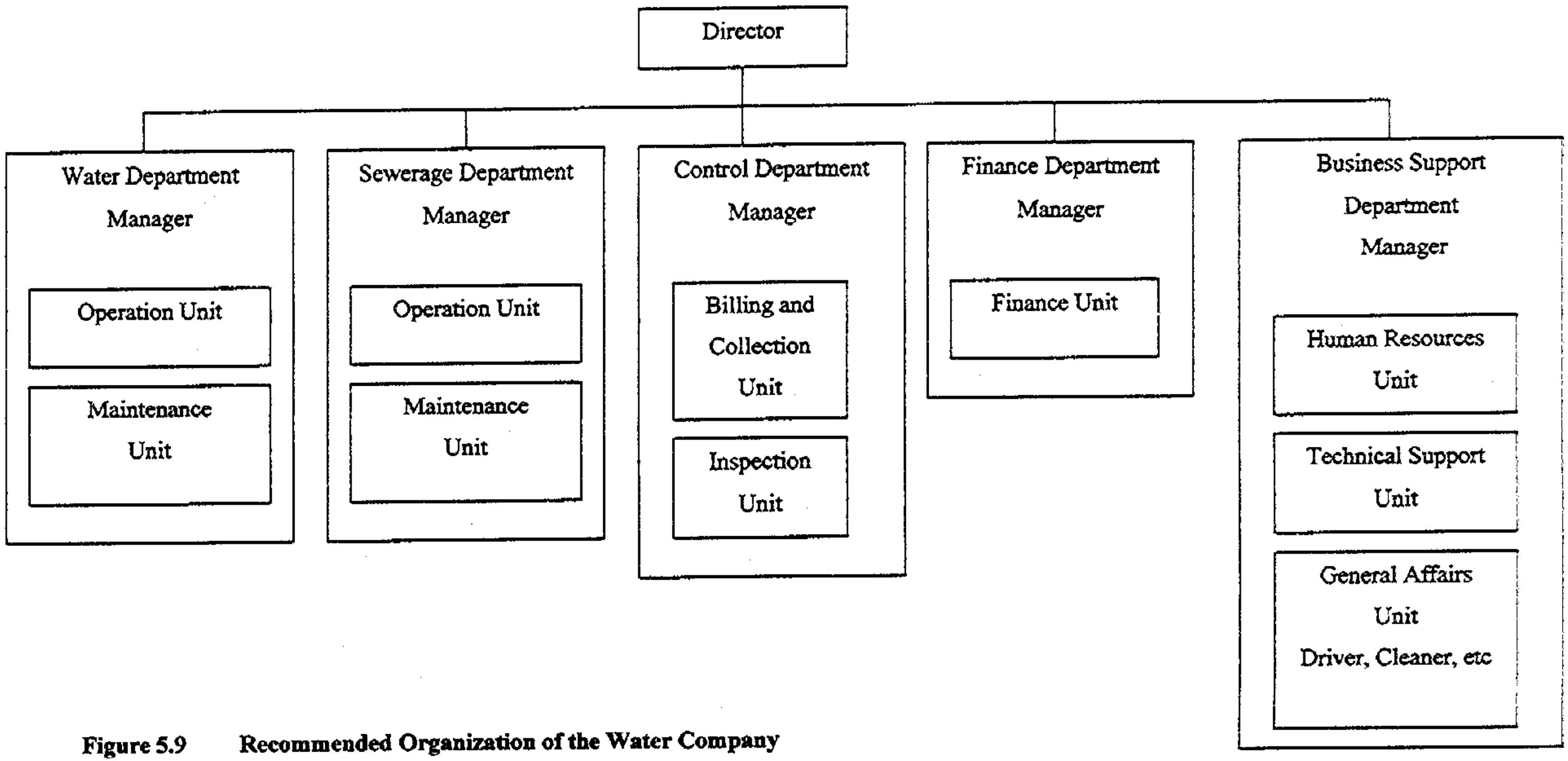


Figure 5.9 Recommended Organization of the Water Company

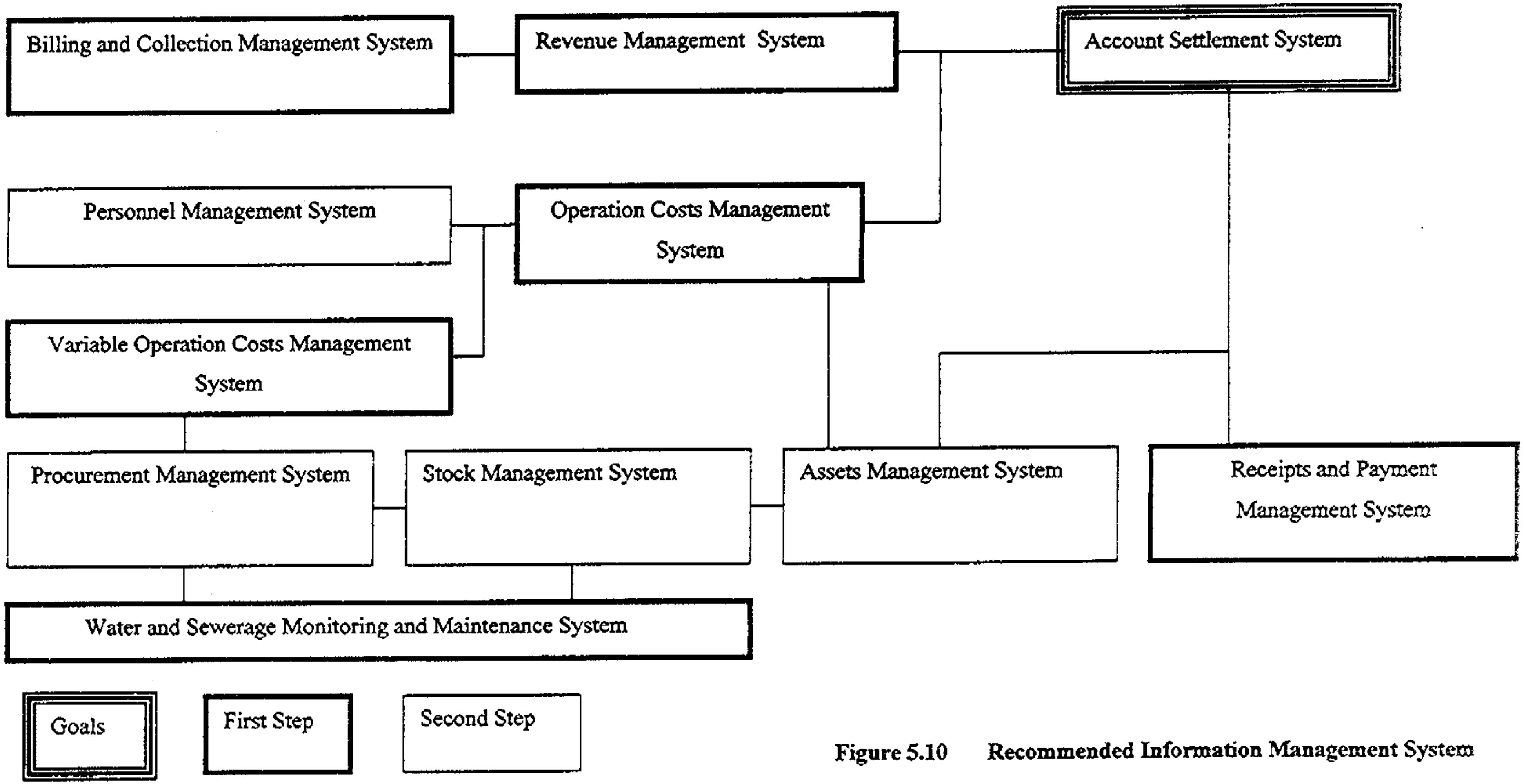


Figure 5.10 Recommended Information Management System

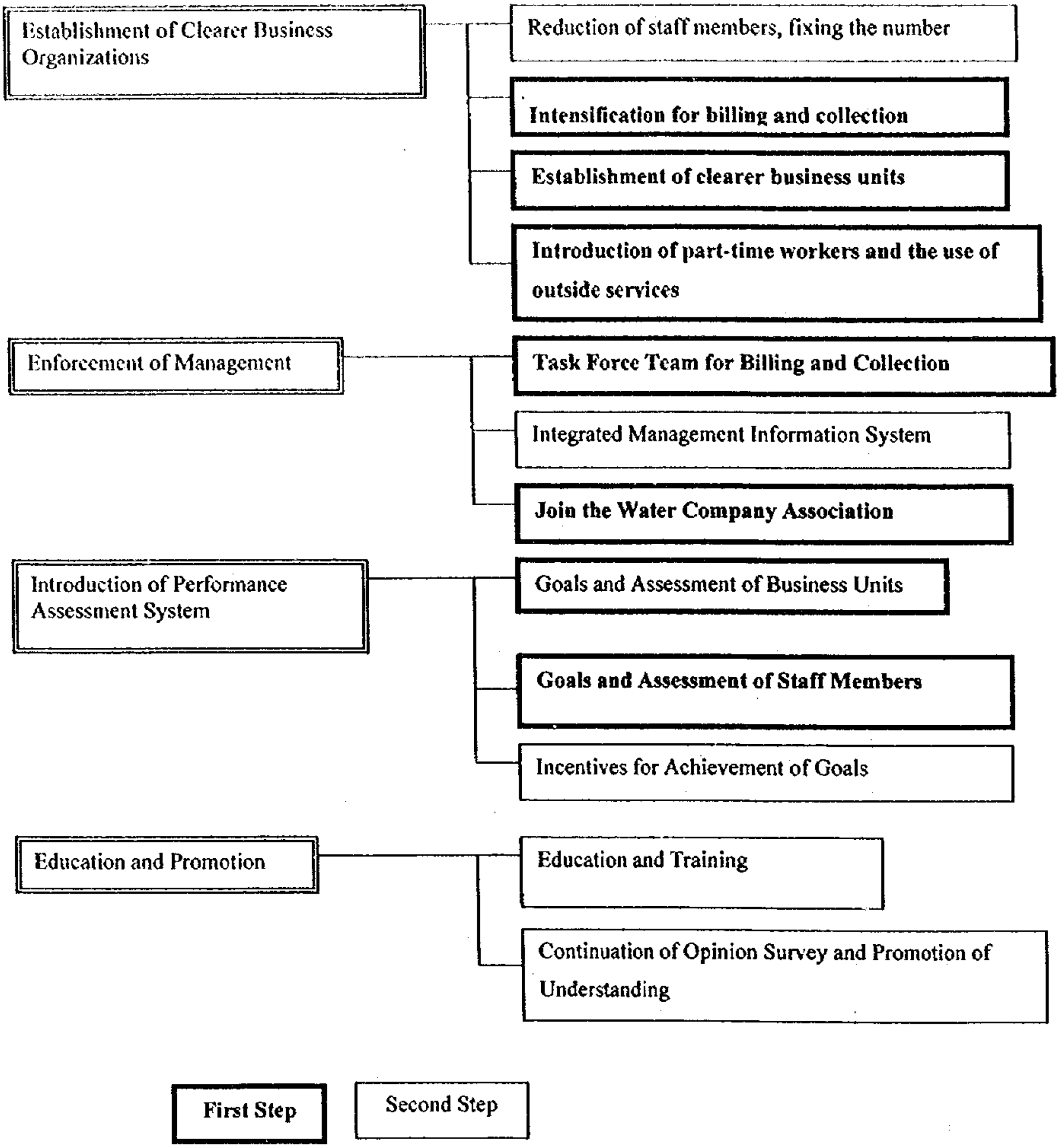


Figure 5.11 Recommended Program Structure for the Skuodas Water Company

5.11.3 Performance Assessment System

5.11.3.1 Goals and Assessments for Business Units

The Water Company may not be familiar with the assessment system for business units. Private or self supporting companies should establish goals to achieve at the start of each fiscal year. The achievement ratio (actual over planned) should be evaluated every quarter or twice a year. The managers of the business units have a responsibility to meet the achievement ratio and staff members of the units share this responsibility when personnel performance is assessed. The company faces lots of problems everyday and this activity seems to be unrealistic because the company is kept busy solving their immediate troubles. The Water Company is however an on-going concern and this activity is important to solve long-term problems systematically and understand why these problems develop.

5.11.3.2 Written Goals and Performance Assessments for Staff Members by Personnel Meetings

All staff members should have clear written goals every year and a performance achievement ratio should be assessed in discussion with each staff member once or twice a year. Goals for individuals are similar and contribute to the success of these of business units. Personnel meetings between the general manager (director) and his staff members should be held once or twice a year focusing on goals and assessments.

5.11.3.3 Incentives for Achievement of Goals

Based on assessment activities, special incentives for achievement of goals should be established.

These special incentives could be as follows, for example;

- Bonus (in accordance with cost savings generated after improvement in the loss)
- Remuneration (in accordance with achievement ratio, for the next years' remuneration)
- Training (in accordance with improvement in the achievement ratio for participating in training courses in their specialty)
- Awards (in accordance with improvement in the achievement ratio by giving an award from the company)

5.11.4 Other Issues in Organization and Management

5.11.4.1 Training and Education

Staff members should be given information on new operation skills and technologies. All staff members should participate in lectures and seminars on worthwhile concerns, especially staff members in the personnel unit of the business support department participating in courses on personnel management and personnel assessment process.

5.11.4.2 Continuation of Opinion Survey and Promotion of Understanding

Some people have complains about the tariff and further increases of the tariff. The Water Company should continue to obtain opinions of its consumers in order to wisely plan for needed tariff increases without regional political problems or a decrease in services. The continuation of opinion surveys and public announcements on improvements in service, outstanding employees, important projects (such as water or wastewater plants) and programs (reduction of costs, improvement of services, changes in billing and collection system, changes in the tariff structure, etc) are important and improve the management of the Water Company.

Recommended program structure is shown in Figure 5.11.

5.12 PROJECT EVALUATION

5.12.1 Rationale of the Project Implementation

Construction of the proposed sewage treatment plant will effectively contribute to the effort being carried out for the environmental protection in the Bartuva River Basin. Implementation of the project should have a high priority considering the present status of the discharge of effluent from the treatment plants in Skuodas.

5.12.2 Project Evaluation

5.12.2.1 Technical Evaluation

The project is evaluated as feasible in terms of technical aspects to meet the effluent standards set by the Ministry of Environment. The proposed oxidation ditch process requires minimal expertise in operation and maintenance so that the Water Company will not need to employ any highly experienced staff for operation.

5.12.2.2 Environmental Consideration

Implementation of the project will not have a serious environmental impact either during the construction period or operation of the treatment plant.

5.12.2.3 Financial Evaluation

The financial analysis shows that the project is financial viable with a reasonable range of tariff setting and assumptions of financial sources in 50 percent of soft loan and 50 percent of state subsidy/grant.

5.12.2.4 Economic and Social Evaluation

The proposed project is expected to contribute to the upgrading of the local economic and social environment.

Living conditions of the residents will also be improved particularly when they have contact with the water of the Bartuva River through their amusement or hobby activities.

CHAPTER 6

ENVIRONMENTAL IMPACT ASSESSMENT

6 ENVIRONMENTAL IMPACT ASSESSMENT

The project features and project environment for the proposed two projects are summarized in Table 6.1 and Table 6.2.

6.1 EIA FOR THE PROJECT AT BIRZAI

6.1.1 Summary of EIA

The conclusion of the EIA on every component is briefly shown in Table 6.3. As seen in the table, none of the environmental components are considered in the A, B or C category. All selected components are categorized as D3, "Almost no impact anticipated", but monitoring will be required. It would be reasonable to conclude that the project may not cause any adverse impact on the environment, due to the following reasons:

(a) The sewerage improvement project is also an environmental improvement project. This kind of project generally does not make an adverse impact and in many cases has only a slight impact.

(b) The environmental issues generally caused by a sewerage improvement project are limited to the following components:

- Relocation and land acquisition
- Waste disposal
- Fauna and flora
- Landscape
- Water pollution
- Noise and vibration
- Odor

(c) The project site is located outside the populated town area, so that most of the above impact components are not serious in comparison with a site located in a densely populated urban area. The water related problems may not happen, as the river receiving the treated effluent is already receiving the effluent from the existing sewage treatment plant. After project completion, the existing plant will be abandoned, so that the river water quality will surely be improved from the present condition. In addition, the project preliminary design takes into account environmental countermeasures such as follows:

- Sludge treatment facility at the STP
- A buffer zone surrounding the STP facilities
- Landscaping
- Architectural design of structures
- Site selection

(d) Concerning the issues during the construction, ordinary countermeasures will be sufficient for preventing environmental nuisances. There are no particular long-term significant conditions from construction.

6.1.2 Mitigation Measures

No adverse impact is anticipated at this stage in the study. Accordingly, no mitigation measures will be required.

6.2 EIA FOR THE PROJECT AT SKUODAS

6.2.1 Summary of EIA

The conclusion of the EIA on every component is briefly shown in Table 6.4. As seen in the table, none of the environmental components are considered in A, B or C category. All selected components are categorized as D, "Almost no impact anticipated". It would be reasonable to conclude that the project may not cause any adverse impact on the environment, due to the following reasons:

(a) The sewerage improvement project is also an environmental improvement project. This kind of project generally does not make an adverse impact or has only a slight impact.

(b) The environmental issues generally caused by a sewerage improvement project are limited to the following components:

- Relocation & land acquisition
- Waste disposal
- Fauna and flora
- Landscape
- Water pollution
- Noise & vibration
- Odor

The project site is located outside the central town area, so that most of the above impact items are not serious in comparison with a site located closer to an urban area. The water related problems may not happen, as the river receiving the treated effluent is already receiving effluent from two existing treatment plants. Upon project completion, the existing sewage plants will be abandoned, so that the river water quality will be improved from the present condition. In addition, the project preliminary design takes into account environmental countermeasures as follows:

- Sludge treatment at the STP
- A buffer zone surrounding the STP facilities
- Site selection
- Landscaping
- Architectural design
- Relocation

(c) Concerning the issues during the construction, ordinary countermeasures will be sufficient for preventing environmental nuisances. There are no particular long-term significant conditions from construction.

6.2.2 Mitigation Measures

No adverse impact is anticipated at this stage in the study. Accordingly, no mitigation measures will be required.

6.3 RECOMMENDATION ON ENVIRONMENTAL MANAGEMENT

The results of the EIA study further suggest that careful attention should be paid in the future during the operation and maintenance stage to assure the environmental status as predicted. Environmental management is concerned with the implementation of the measures necessary to minimize or offset adverse impacts, if any, and to enhance beneficial impacts. Unless management is sufficiently implemented, it is probable to cause an unexpected adverse impact.

The EIA also concluded that the project implementation will not cause a definite adverse impact. The project will rather contribute significantly to improve the overall environment of the project area. It is, however, recommended to ascertain the environmental improvement by proper environmental management.

Table 6.1 Project Features

Item	Description
Project Name	Sewerage System Improvement for Birzai and Skuodas Town in the Republic of Lithuania
Background	In both towns of Birzai and Skuodas, the existing sewerage systems are deteriorated and the treatment capacity is not sufficient. The existing treatment plants are not properly operable at present and the insufficiently treated effluent is released to the rivers, which causes water pollution not only in rivers but also in groundwater. The water pollution problem also becomes an international claim as the rivers run down to the Baltic sea through the neighboring country, Latvia. The government of Lithuania had prepared sewerage improvement plans for both towns to solve the problems and construction works have been partially started. However, the contents of the plans are not definite enough and the construction was suspended. It was decided to review the existing conditions and reformulate the plans.
Purpose of this study	To conduct a feasibility study for improvement of sewerage system that will contribute to the upgrading of sanitary and environment conditions in Birzai and Skuodas towns for the target year of 2010.
Location	Town of Birzai is located close to the northern border with Latvia and approximately 200km away in a north-northwest direction from Vilnius. Town of Skuodas is located facing Latvia, close to the Baltic Sea on the west, and approximately 350km away from Vilnius in a northwest direction.
Executing Agency	Ministry of Environment, Municipality Government of Birzai, and Municipality Government of Skuodas
Population of Beneficiaries	Population served (2010) : 11,720 in Birzai and 8,340 in Skuodas
Project Features	
-Objective Structures	Treatment plants to be newly constructed. (the existing sewer systems are to be used as it is)
-Objective Areas	Town areas of Birzai (1,783 ha) and Skuodas (596 ha). Additional areas may be included if the town areas are to be expanded before the year 2010.
- Sewerage Type	Separate Sewer System (in both towns)
-Treatment Plant	Birzai : Area of 2.7 ha with 5,000 m^3/d in daily max. capacity. Skuodas : Area of 1.8 ha with 1,600 m3/d in capacity.
-Treatment Method	Birzai : Anaerobic-anoxic-aerobic (A2O) method Skuodas : Oxidation ditch method
-Sewer Length	Birzai:27km (existing), Skuodas : 23 km (existing)
-Effluence Release	Birzai: Juodupe river (2km new discharge pipe), Skuodas: Bartuva river (0.6km new drainage pipe)
-Effluent water quality (Average)	Birzai (to Juodupe) : BOD7 4mg/l, SS 30mg/l, TN 8mg/l, TP 1.0mg/l Skuodas: BOD7 15mg/l, SS 30mg/l, TN 20mg/l, TP 1.5mg/l
Others	Latvian government requests that Skuodas improve the water quality of the Bartuva River.

Table 6.2 Project Environment

Item		Description
Project Name		Sewerage System Improvement of Birzai and Skuodas towns in the Republic of Lithuania
Social Environment	Inhabitants	The beneficiaries are primarily living in town. At the proposed treatment sites, there are no houses in Birzai, but one in Skuodas. Both areas are owned by the state.
	Land use	In Birzai, the STP site is vacant and covered with grass. The surrounding area is a rural area of grassland and farming land. In Skuodas, the STP site and the surrounding area is used for farming.
	Economy/ Traffic	No remarkable economic activity is found at the proposed STP sites, but agricultural use nearby. The rural roads have little traffic. The residential area is located in town. In Birzai, there are some middle-scale factories near town. In Skuodas, only one middle-scale factory.
Natural Environment	Topography and Geology	Generally flat land. The geological condition in Skuodas has no significant issues. But, in Birzai the active karst zone is widely located.
	Coastal zone condition	Nothing special.
	Endangered Fauna & Flora	No significant fauna & flora is at the STP sites. In the rivers, however, some protected species of fish and animals are recorded, although they are not endangered species.
Pollution	Significant Claim	Latvia claims Skuodas is polluting the surface waters. Groundwater pollution in Karst area of Birzai.
	Counter measures	Necessary to improve the sewerage treatment plants in both towns.
Other matters		In Birzai, the treatment plan was previously established, however the construction was suspended. For Skuodas, an initial design was prepared, but construction was not started.

Table 6.3 Brief Results of EIA for the Selected Components (Birzai)

No.	Component	Impact	Remarks
1	Relocation	D2	Land acquisition for the effluent pipeline is to be verified.
6	Vested right	D2 & D3	Vested right in the Juodupe and Tatula rivers is to be verified. Monitoring of water quality will be required.
7	Health and Hygiene	D3	Monitoring of water quality in the river and groundwater will be required.
8	Waste disposal	D3	Monitoring of actual conditions of the sludge treatment and its disposal will be required.
10	Topography and Geology	D3	Monitoring of any change to the geological condition (karst) will be required.
12	Groundwater	D3	Monitoring of any change in the groundwater condition (karst), including water quality, will be required.
13	River & Lake	D3	Monitoring of water quality in the rivers and groundwater will be required.
15	Fauna & Flora	D3	Monitoring of water quality in the rivers will be required. A regular survey/monitoring of fauna & flora in the Juodupe and Tatula Rivers will be necessary.
17	Landscape	D2	It will be required to landscape the proposed facilities.
19	Water pollution	D3	Monitoring of water quality in rivers and groundwater will be required.
20	Soil Contamoination	D1	No adverse impact is expected if the sludge is treated as planned.
23	Odor	D3	Monitoring of actual condition of odor will be required. Containment of odors at the STP should be considered.

Score:

A- Significant impact anticipated
B- Slight impact anticipated
C- Unknown (subject to further verification)
D1- Almost no impact is anticipated
D2- Almost no impact is anticipated, but to be verified.
D3- Almost no impact is anticipated,
but monitoring will be reqiured.

Table 6.4 Brief Results of EIA for the Selected Components (Skuodas)

No.	Component	Impact	Remarks
1	Relocation	D2	Necessity of land acquisition and relocation of a house is to be verified.
6	Vested right	D2 & D3	Vested right in Bartuva river is to be verified. Monitoring of water quality will be required. The water use rights on the Latvian side needs to be verified.
7	Health and Hygiene	D1	No monitoring will be required.
8	Waste disposal	D3	Monitoring of actual conditions of the sludge treatment and its disposal will be required.
10	Topography and Geology	D1	No monitoring will be required.
12	Groundwater	D1	No monitoring will be required.
13	River & Lake	D3	Monitoring of water quality in the Bartuva River including the Latvian side will be required
15	Fauna & Flora	D3	Monitoring of water quality in rivers will be required. A regular survey/monitoring of fauna & flora in the Bartuva River and its tributaries , including the Latvian side, if possible, will be necessary.
17	Landscape	D2	It will be required to landscape the proposed facilities.
19	Water pollution	D3	The monitoring of water quality in rivers and groundwater will be required.
20	Soil Contamoination	D1	No adverse impact is expected if the sludge is treated as planned.
23	Odor	D3	Monitoring of actual condition of odor will be required. Containment of odors at the STP should be considered.

Score:
A- Significant impact anticipated
B- Slight impact anticipated
C- Unknown (subject to further verification)
D1- Almost no impact is anticipated
D2- Almost no impact is anticipated, but to be verified.
D3- Almost no impact is anticipated, but monitoring will be reqiured.

CHAPTER 7

CONCLUSIONS AND RECOMMNDATIONS

Nippon Jogesuido Sekkei Co., Ltd.
Tokyo, Japan

7 CONCLUSIONS AND RECOMMNDATIONS

7.1 CONCLUSION FOR BIRZAI

The proposed Birzai Sewerage System Improvement Project is evaluated feasible in terms of technical, economical, financial and environmental aspects. Two options are finally evaluated feasible as follows:

Option 1

Project components for the Birzai Project consists of the following:

- 5,000 m^3/day Sewage Treatment Plant

secondary treatment:	anaerobic-anoxic-aerobic system and sedimentation
tertiary treatment:	biological membrane filter
sludge treatment:	mechanical dewatering and transfer for composting

- Effluent discharge pipeline to the Juodupe River
  (3,250 m long, 400 mm diameter, reinforced concrete pipe)
- Expansion of pump operation monitoring system
- Structural repairs at the existing pump stations
- Demolition of the existing treatment plant.

Project cost: Lt.11.7 million

Option 2

Project components for the Birzai Project consists of the following:

- 5,000 m^3/day Sewage Treatment Plant

secondary treatment:	anaerobic-anoxic-aerobic system and sedimentation
sludge treatment:	mechanical dewatering and transfer for composting
effluent discharge pump station:	

- Effluent discharge pipeline to the Obelaukias River
  (7,000 m long, 300 mm diameter, ductile iron pipe)
- Expansion of pump operation monitoring system
- Structural repairs at the existing pump stations
- Demolition of the existing treatment plant.

Project cost: Lt.17.6 million

For the two options above, Option 1 is recommended to implement because of its greater advantage of smaller cost in construction. Operation cost of Option 1 is also smaller than that for Option 2 if the tertiary treatment is not provided. As described in the following section, construction of the tertiary treatment may be excluded from the first phase of the construction work for saving the cost.

7.2 RECOMMENDATIONS FOR BIRZAI

7.2.1 Recommendations for the Project Implementation

For the implementation of the proposed project, there are several measures to be addressed in prioritizing the construction. The following options should be considered in the construction program of the recommended facilities

- **Tertiary Treatment Process**

  For the tertiary treatment process at the new treatment plant, the Ministry of Environment may have an opportunity to review the special effluent requirements for the Tatula River taking into account the actual treatment performance of the new treatment plant as well as the river water quality. This option is recommended for reducing the initial construction cost of the treatment plant by 1.30 million litas.

- **Chemical Dosage Facilities**

  Dosage of chemical coagulant is provided at the new treatment plant for phosphorus removal to 1.5 mg/l. Installation of this facility may be differed to reduce the construction cost. With the same reasoning for delaying the construction of the tertiary treatment, treatment performance in the actual operation must be examined. Construction cost may be reduced by 240,000 litas with this option.

  Operation cost will also decreased by 7,800 litas per year.

- **Cost Reduction**

  With the optional measures above, saving in the construction cost will be about 15 percent of the total construction cost as summarized as follows:

Option 1

by delaying the tertiary treatment system:	Lt.1.30 million
by delaying the chemical dosage system:	Lt.0.24 million
Total	Lt.1.54 million
Total Construction Cost after Cost Reduction	Lt.8.62 million

Option 2

by delaying the chemical dosage system:	Lt.0.24 million
Total Construction Cost after Cost Reduction	Lt.15.26 million

7.2.2 Future Expansion of the Treatment Plant

When the treatment plant will need to treat larger amount of sewage than its design capacity in future, after 2010, the plant can increase its capacity by constructing an additional biological treatment unit.

For Birzai, sewage transmission pipelines have sufficient capacity to convey sewage in larger amount than the design capacity of the treatment plant. Transmission capacity of the pipeline is more than double the capacity of the treatment plant. Capacity of the entire system can therefore be increased only by increasing the treatment capacity.

7.2.3 Improvement of Sewerage Treatment in the Upstream of the Tatula River Basin

It is suggested that investment be allocated for construction of secondary treatment (biological treatment) facility in as many local communities as possible rather than constructing a tertiary treatment facility for Birzai. The special standard for the Tatula River may have to be reviewed from the viewpoint of effective use of funds.

7.3 CONCLUSION FOR SKUODAS

The proposed Skuodas Sewerage System Improvement Project is evaluated feasible in terms of technical, economical, financial and environmental aspects.

Project components for the Birzai Project consists of the following:

- 1,600 m^3/day Sewage Treatment Plant
  - secondary treatment: oxidation ditch system and sedimentation
  - sludge treatment: mechanical dewatering and composting
- Connection of 100 mm ductile iron pipe from the Pump Station No.2 to the existing pressure main from the existing treatment plant No.1 to the new treatment plant site.
- Demolition of the two existing treatment plants

Project cost: LTL. 7.7 million

7.4 RECOMMENDATIONS FOR SKUODAS

7.4.1 Recommendations for the Project Implementation

For the implementation of the proposed project, there are several measures to be addressed in prioritizing the construction. The following options should be considered in the construction program of the recommended facilities

- Dosage of chemical coagulant will be provided at the new treatment plant. Installation of the chemical coagulation system may be differed to reduce the construction cost. Construction cost may be reduced by 200,000 litas with this option. Operation cost will also decreased by 18,000 litas per year.

7.4.2 Future Expansion of the Treatment Plant

When the treatment plant will need to treat larger amount of sewage than its design capacity in future, after 2010, the plant can increase its capacity by constructing an additional biological treatment unit.

For Skuodas, sewage transmission pipelines have sufficient capacity to convey larger amount of sewage than the design capacity of the treatment plant. Transmission capacity of the pipeline is more than three times the capacity of the treatment plant. Capacity of the entire system can therefore be increased only by increasing the treatment capacity.

7.5 GENERAL RECOMMENDATIONS

7.5.1 Recommendations for the Tasks of Consultant

In various stages in the implementation of the project, emphasis should be given to the engineering services normally provided by the consultants. Such service should include the activities as follows:

- detailed design of facilities including topographic survey, soil investigation etc.;
- preparation of technical specifications for both construction and equipment supply;
- preparation of tender documents;
- assistance for the Water Company or Ministry of Environment in pre-qualification of contractors, tendering, and award;
- construction supervision at site and shop testing;
- testing of the plant and commissioning;
- training for the Water Company in the operation of the treatment plant;

7.5.2 Recommendations for Industrial Wastewater Control

Control of the industrial wastewater will be required for the efficient management of the sewerage system as well as environmental protection. A proper legislation system for control of the industrial wastewater should be established at the earliest stage.

For maintaining stable operation of the treatment plants, BOD in the industrial wastewater must be controlled below a certain level. For example, in Japan, BOD in the industrial wastewater is not allowed to exceed 600 mg/l.

Control of the industrial wastewater should require the government to establish a legislative formation that could restrict discharge of high organic wastewater into the sewerage system. Without clear standards for effluent from the industries, it would be difficult and uneconomical to design the pre-treatment process at each industry.

7.5.3 Reduction of Groundwater Infiltration

In Birzai, about 50 percent of the sewage flow is groundwater infiltration. Reducing the amount of infiltration will directly contribute to prolonging the life of the treatment plant. Prior to repair work for the sewer pipeline, investigation for the infiltration should be conducted. Priorities in the repair work will then need to be established based on the amount of infiltration and cost of repair of pipes. Economic study for the pipe repair and increase of the plant capacity should also be conducted to achieve the effective investment.

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