4.11 CONSTRUCTION PLAN AND PROJECT COST ESTIMATES

4.11.1 General

This Section will discuss planning for construction and detail the construction schedule for Birzai. The basic unit costs used in estimating the construction cost and other costs which have been included to arrive at a project cost are shown and discussed.

The major elements to be constructed in Birzai includes:

-Completion of a modified treatment plant (A2O Process)
-Effluent pipeline to the Juodupe River, 2,000 m
(Alternative 1 as the most costly option)
-Effluent pump station
-Modifications to two existing pump stations
-Demolition of existing treatment plant

The new effluent pipeline is relatively small in size (300 mm) and length (2,000 m) and is considered an item which could be constructed by a competent civil contractor experienced in treatment plant construction. Pump station modification is also similar to the treatment plant construction work proposed. It is therefore recommended that a single contractor, experienced in treatment plant construction, construct all of the major elements of work.

The two towns of Birzai and Skuodas are about 350 km apart and management of two construction projects at the same time by a single contractor would be difficult. The sizes, process and equipment also are different at each site. For these reasons, it is recommended that two construction contracts be prepared, one for each town.

The treatment plant at Birzai will have minimal mechanical equipment, all in the mid-range of available sizes. To maintain single unit responsibility for completion of construction on schedule, a separate procurement contract is not warranted. Because of the number and size of the equipment, it is believed that any savings in cost by purchasing the major equipment for both Birzai and Skuodas by a single package would be minimal. Each contractor (one at each plant) would be responsible for purchasing the equipment required.

Likewise, because of the numbers and sizes of the equipment, a separate contract for mechanical and electrical work (procurement and installation) would not benefit the project to any great extent. A separate contract would also allow the civil contractor to blame the mechanical/electrical contractor for delaying his work, and vice versa. Therefore, it is proposed that a single contractor perform both the civil and mechanical/electrical work. If necessary, a contractor could hire a subcontractor to perform portions of the work but only the main contractor would be responsible for insuring the subcontractor finished his work without delay to the main contract and that the entire work was completed on schedule.

In summary, it is suggested that a single construction contract be prepared for each town incorporating both civil work and mechanical/electrical procurement and installation. The contract

should also include testing and start-up of the facilities and operation, maintenance and training for a period of time after commissioning. Construction contracts would then be advertised for competitive bidding with the lowest priced contractor awarded the work.

To insure that only competent contractors bid the work, it is recommended that a prequalification process occur during the design period to obtain a list of prequalified contractors. Plans and contract documents would then only be issued to the list of prequalified contractors for bidding purposes.

4.11.2 Construction Plan

The construction plan is composed of many elements. To simplify the plan, only two major parts are considered. These are the construction of the civil works (earthworks, structures, piping and buildings) and plant equipment works which includes the mechanical/ electrical work (manufacture, delivery and installation) and instrumentation work. Several constraints exist which any planning for construction (and for design) must take into account. These include:

- Use of the sites previously purchased for the improvements, to the extent possible.
- Use of any previously constructed facilities, without major modification, to the extent possible.
- Long and cold winter seasons and wet summer.
- High groundwater
- Frozen soil during the winter.
- Unavailability of skilled labor in the local area.

It may be necessary to provide transport for skilled workers from the larger nearby cities.

4.11.2.1 Civil Work

The civil work will begin immediately after mobilization. Mobilization includes the contractor bringing his construction equipment to the site and mobilizing his forces for construction. The contractor will also set up local construction offices including offices for the resident inspectors, storage facilities for equipment and materials delivered early and a concrete batch plant to produce concrete for the various structural elements.

Civil work includes connecting the incoming pressure mains to the new plant and constructing the effluent pressure pipeline, completing the rough grading and excavation for the structures, foundation preparation, in-situ concrete structures, yard piping, buildings, finish grading, paving and drainage work, landscaping, fencing and demolition. This work will continue over the entire summer construction period, weather permitting. Pre-cast concrete work can be completed in a factory and stored for erection in the spring.

Completion of the A2O tanks at Birzai is a major concern. Care will be required in final design by an experienced structural engineer. Leakage through the joints must be prevented.

Otherwise, corrosion of the rebar holding the wall panels together could occur resulting in failure of the walls.

The existing steel rebar welded to the steel plate in each wall section tying the walls together must also be sandblasted to remove paint and rust. Mortar must then be pumped under pressure to seal the opening between the wall panels and to cover the welded rebars. All steel should have at least 25mm of concrete or mortar covering. A watertight joint may require an epoxy sealant between the new and old concrete, particularly where the tank wall also forms one wall of the equipment room that will accommodate sludge pumps, blowers, chemical feeding equipment, and effluent/plant pumps. The joints on all installed wall panels are not completed. Some have only welded rebar at a single location. Rust inhibitor was placed over all joints except those where the joints were not welded together.

It appears that all pre-cast concrete work for the A2O tanks was completed and stacked on-site awaiting installation. This includes the influent channels, the walkways over the tank and the missing aeration reactor walls.

The entire outside and inside foundation was covered by boards and straw or by chaff for protection from freezing. This protection must be removed prior to raising the pre-cast walls, completing the wall joints and placement of embankment.

Several of the other structures (receiving box, grit chamber, flow metering facility and drainage pump station) at the treatment plant were partially completed and will be incorporated in the new design for similar facilities to the extent possible.

4.11.2.2 Plant Equipment Work

Plant equipment work includes the manufacture, delivery and installation of the plant mechanical, electrical and instrumentation equipment. The installation schedule depends upon the manufacture and delivery period. Some off-the-shelf items such as small pumps, valves, etc. can be installed once the structures are completed but for the larger items, time must be allowed for ordering, designing, shop drawing approval by the engineering consultant, manufacture, shipping and delivery. The plant equipment installation work usually begins much later than the civil work and finishes late in the construction period but allowing time for installation, final testing and start-up. Plant equipment can be delivered but must be stored indoors, out of the weather, until the civil work is ready for the installation. Installation can be performed indoors during the winter with proper heating, as required.

It was also planned during the previous construction to install a mechanical bar screen in the wet well of Pump Station No.2. This equipment was however, not installed. Under this study, the mechanical bar screen is proposed to be placed at the treatment plant, eliminating the need for such a screen at the pump station as well as the other previously proposed improvements (electrical, ventilation, structural) to accommodate the screen in the existing pump station wet well.

4.11.2.3 Construction Schedule

An overall construction schedule for Birzai is presented in Figure 4.17. Because some 90 percent of the structural work for the aeration reactor is complete, the schedule for Birzai has been reduced from the 36 months originally specified in 1994. The schedule for Birzai is now some 13 months long. A facilities construction schedule, shown in Figure 4.18, shows a schedule for the various components of the work.

Testing and startup includes testing of individual equipment items and process units. The entire treatment facility would then be brought on line to prove it performs as specified. During this period, the contractor would also train the Water Company personnel in operation and maintenance.

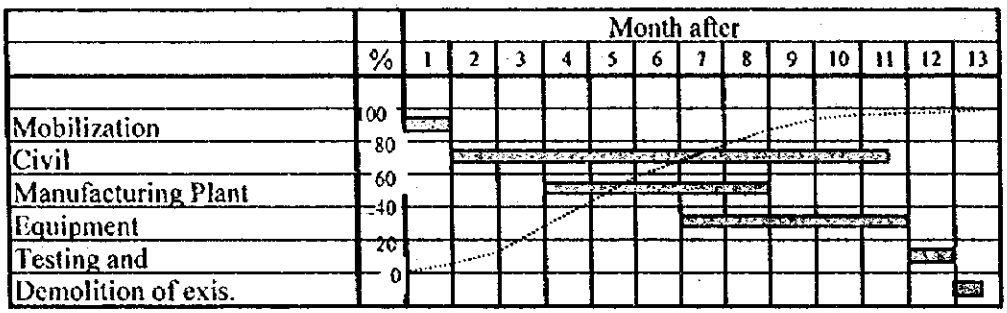


Figure 4.17 Overall Construction Schedule

It appears that the construction contract may be awarded late in the winter and therefore the first several months for the contractor would be spent on mobilization, ordering equipment, factory pre-casting, reviewing shop drawings and planning for his summer activities. The construction period for Birzai would cover two winter seasons with the second requiring most work to be performed indoors, installing equipment, etc. These factors were considered in estimating the construction schedule.

The contractor would be required by the contract documents to submit, after award, his construction schedule based upon his methods of construction in sufficient detail to show chronological relationships to all activities of the project. These include:

-Estimated starting and completion dates
-Submittal of shop drawings for approval
-Procurement of materials
-Scheduling of equipment manufacture, delivery and installation
-Civil work sequences

The schedule would reflect the completion of work within the time specified in the contract documents.

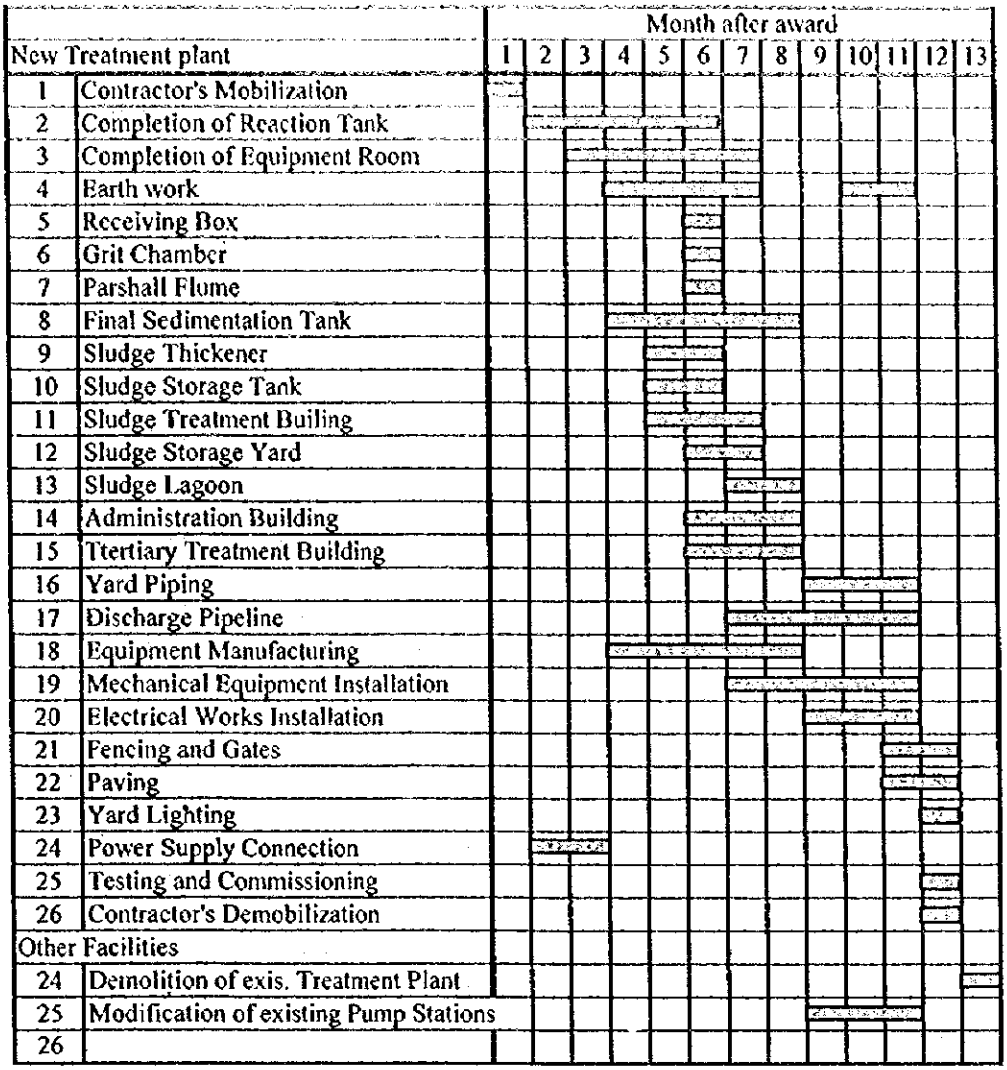


Figure 4.18 Facilities Construction Schedule

4.11.2.4 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.

Inspection at the factory of pipe and equipment manufactured outside Lithuania is not considered necessary.

4.11.3 Basis of Cost Estimate

In the following sections, the basis for cost estimating is discussed. The basis is in general, a time and material estimate where civil work is estimated by the amount of labor required, the necessary materials to be incorporated in the work and the construction equipment time required to perform the work. Plant equipment work is estimated by the cost of imported and local equipment and installation, testing and start-up costs.

To determine the beginning and midpoint of construction for the financial analysis and cost estimating purposes, a schedule for the pre-construction activities was developed, as shown in Figure 4.19.

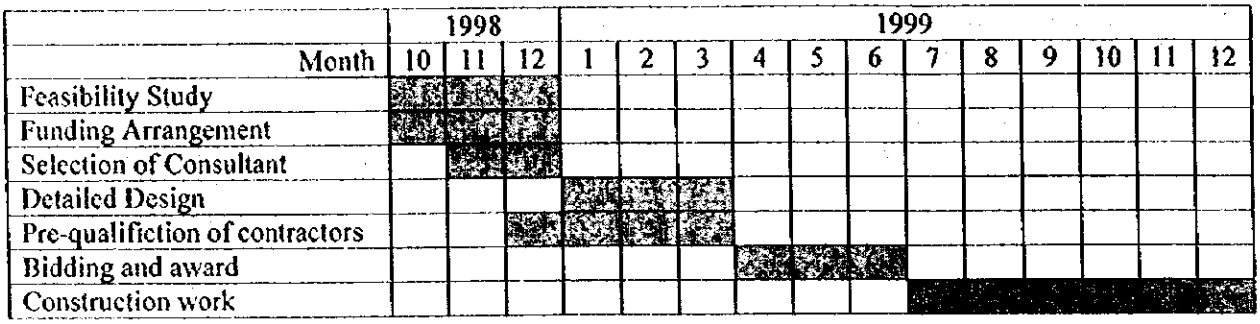


Figure 4.19 Schedule for the Pre-construction Activities

4.11.4 Basic Unit Costs

A unit cost includes several basic items, i.e. pipe laying, which includes excavation, the price for delivered pipe, lowering the pipe into the excavation upon the pipe bedding, joining the pipe together, checking the grade and applying any pipe joint protection (such as wrapping or painting), backfill, compaction, testing and hauling waste material from the site. These unit costs are based upon an average basic unit cost for labor, materials and construction equipment. Basic unit costs used in these cost estimates are shown in the following Table 4.53 for construction equipment.

4.11.4.1 Construction Materials

Unit costs for construction materials were obtained from suppliers and previous construction contracts updated to July 1998 for both local and imported materials. Unit costs used herein are shown in Table 4.54.

4.11.4.2 Equipment

Equipment to be incorporated into the Birzai treatment plant and the cost thereof is shown in Table 4.55. The prices are shown in litas as of July 1998 and shipping and insurance costs are included. The value added tax of 18 percent is not included.

4.11.4.3 Labor

Labor unit costs are shown in Table 4.56, as of July 1998 for the various categories of personnel as defined in Lithuania to be involved in construction activities.

4.11.5 Construction Costs

The construction costs for the two Options for the Birzai project are shown in Table 4.57 and Table 4.58. To determine the construction cost for Birzai, it was necessary to take into account that about 16 percent of the work was previously completed in 1994. This percentage included some 9 percent complete at the treatment plant and 23 percent complete for the pump station, influent pipeline and the effluent pipeline to the river. The cost also takes into account that certain portion of the previous work must be modified or abandoned to fit the proposed new design.

A 5 percent contingency has been added to both the material and equipment costs. Twenty percent has been added to the labor cost for only those personnel who perform seasonal (15%) or specialty (5%) work. A further 17.3 percent has been added to the labor cost for field supervision (foreman) cost. Supervision and overhead by the contractor are included at 70 percent and social insurance on the total labor cost is also shown at 30 percent. A contingency of 3 percent is added to cover price variance and a profit for the contractor of 10 percent is included. A value added tax of 18 percent of the total has been included.

Table 4.53 Basic Unit Costs for Construction Equipment

Type of Equipment	Rates (Lts/hour)	Type of Equipment	Rates (Lts/hour)
Backhoe	48.00	Pipe Jack	48.00
Grader	40.50	Concrete Batch Plant	43.50
Bulldozer	35.00 to 69.50	Asphalt Batch Plant	28.50
Front - End Loader	45.50	Paving Machine	43.50
Compactor	35.00	Rebar Bender	58.00
Dump Truck	39.50	Vibrators	28.00
Crane	40.50	Concrete Buggies	40.50
		Fork Lift	50.20

Table 4.54 Unit Costs for Construction Materials

Type of Material	Unit	Rate (Lts/unit)	Type of Material	Unit	Rate (Lts/unit)
Excavation	cu m	2.15	Asphalt Pavement	sq m	112.12
Backfill and Compaction	cu m	5.35	PVC Pipe		
Embankment	cu m	1.23	100mm	m	86.45
Sand	cu m	9.50	150mm	m	107.34
Gravel	cu m	16.48	200mm	m	117.84
Steel Reinforcement	ton	261.99	250mm	m	154.97
Cast-in- Place Concrete			300mm	m	201.19
Slab	cu m	878.00	DI Pipe		
Wall	cu m	1,196.00	300mm	m	301.92
Miscellaneous	cu m	1253.00	400mm	m	425.19
Precast Concrete			RC Pipe		
Slab	cu m	610.09	400mm	m	155.93
Wall	cu m	1,111.33	500mm	m	211.76
Miscellaneous	cu m	1,221.25	600mm	m	238.70
Foundation	sq m	55.00			
Fencing	m	98.09			

Table 4.55 Cost of Equipment Incorporated in the Project

Item of Equipment	No. of Units/Sets	Unit Cost	Total Cost
Mechanical Bar Screen	1	89,000	89,000
Bypass Screen	1	2,100	2,100
Sand Pump	1	7,500	7,500
Flow Monitoring Equipment	1	16,000	16,000
Stop Logs	4	2,000	8,000
Reaction Tank Mixer (1.1Kw)	3	20,000	60,000
Reaction Tank Mixer (2.4Kw)	9	22,000	198,000
Diffusers	840	360	302,400
Aeration Blowers	3	37,000	111,000
Re-circulation Pump	3	16,600	49,800
Coagulant Tank	1	37,300	37,300
Coagulant Feed Pump	2	8,500	17,000
Caustic Soda Tank	1	32,000	32,000
Caustic Soda Feed Pump	2	8,500	17,000
Final Sedimentation Tank Mech.	2	150,350	300,700
Return Sludge Pumps	4	11,000	44,000
Excess Sludge Pumps	2	13,300	26,600
Plant Water Pump	1	7,500	7,500
Effluent Discharge Pump (Option 2 only)	2	16,200	32,400
Sludge Thickener	1	69,000	69,000
Thickened Sludge Pumps	2	21,300	42,600
Sludge Mixing Blower	1	5,000	5,000
Sludge Feed Pump	1	21,300	21,300

Table 4.55 Cost of Equipment Incorporated in the Project (continued)

Item of Equipment	No. of Units/Sets	Unit Cost	Total Cost
Sludge Dewatering Unit	1	228,000	228,000
Sludge Cake Conveyor	1	21,500	21,500
Polymer Tank	1	32,000	32,000
Polymer Feed Pump	1	7,500	7,500
Drain Pump	1	6,300	6,300
Standby Water Pump	1	7,500	7,500
Standby Sludge Pump	1	10,500	10,500
Well Pump	1	12,500	12,500
Hoist	5	1,000	5,000
Septage Transfer Pump	1	6,300	6,300
Biological Membrane Filter (Option 1 only)			
Biological Membrane Filter	3	95,700	287,100
Feed Pump	3	17,300	51,900
Aeration Blower	2	13,100	26,200
Air-Wash Blower	2	15,000	30,000
Backwash Pump	3	15,200	45,600
Drain Pump	2	3,600	7,200
TOTAL (Option 1)			2,248,900
TOTAL (Option 2)			1,833,300

Table 4.56 Unit Labor Costs

Occupation	Rate (Lts/hour)	Occupation	Rate (Lts/hour)
Pipe Fitter	7.91	Laborer	7.91
Excavator Operator	9.11	Equipment Operator	10.64
Truck Driver	7.91	Mechanic	9.11
Concrete Plant Operator	9.11	Surveyor	9.11
Carpenter	9.11	Engineer	10.64
Steel Worker	9.11	Electrician	10.64
Vibrator Operator	10.64	Compressor Operator	9.11
		Welder	9.11

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. The site would be left in a condition for further development by the Water Company or sale.

Table 4.57 Construction Costs for the Birzal 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 Judope 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 4.58 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**

4.11.6 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 4.59.

Table 4.59 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

4.11.7 Other Costs

Other costs shown in Table 4.60 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.

Engineering costs are usually reimbursable under the grant or loan from funding agencies. These costs include final design and construction inspection services, topographical survey and geotechnical work as well as assistance in tendering and award.

The Birzai Water Company has limited equipment for operation and maintenance consisting of one excavator, two tractors and two cars. No laboratory or diagnostic equipment is available. All operational testing must be performed by an outside laboratory. Costs have therefore been included for additional operation and maintenance equipment and laboratory supplies needed for operational control, in the capital cost.

Table 4.60 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.

4.11.8 Project Cost

The final project cost is shown in Table 4.61 and includes the construction cost, operation and maintenance cost, and other costs including land acquisition, administration and engineering cost and a project contingency of five percent. Project cost is shown in local and foreign costs. Foreign cost is the amount required to purchase services, materials and equipment from sources outside Lithuania. This includes the mechanical, electrical and instrumentation equipment to be incorporated into the work, pressure piping, operation and maintenance equipment, portions of the engineering services and some construction materials and equipment.

Table 4.61 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 4.62 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

4.12 FINANCIAL, ECONOMIC AND SOCIAL ANALYSIS

4.12.1 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.

4.12.1.1 Methodology of Financial Analysis

A cash flow based (net profit plus depreciation) model was run to calculate the FIRR (Financial Internal Rate of Return) for the proposed sewerage project. It is the best base and start point to analyze the financial feasibility of the project, because of the following features:

- The cash flow based FIRR method considers fully the time value of all cash outflows and inflows.
- The minimum tariff required to ensure a positive FIRR is projected.
- FIRR is calculated under given tariff conditions. Financial feasibility of the project is evaluated from the FIRR calculated;
- The calculated FIRR will be a hurdle rate in valuing the project financially in the following aspects:
    - If the average total cost of the project is higher than the predicted FIRR, the project is evaluated not financially feasible.
    - FIRR is used to compare with certain required or a target level of the project.
    - It is an easily understandable standard in comparing and choosing among different financing sources.

Different leveraged cases (using some loan conditions) have been calculated and analyzed. The financial model established in this study has following features:

- It models only the sewerage collection and treatment division of the Water Company. Water supply and other business of the Water Company are not included in this model.
- The model generates a pre-forma cash flow statement, mainly based on the profit and loss account. Both the cash flow statement and profit and loss account have been calculated for 25-years from the beginning of the project.
- Income of the project is calculated from two groups of customers by multiplying the estimated chargeable volume of sewage and tariff.
- Domestic consumption (and supply) of water and discharge of sewage are estimated to increase around 4 percent each year during the first 10 year period, and to maintain at the same level at the other 15 year period.
- Industrial users will maintain their current consumption for water and discharge of sewage. No new industrial establishments are planned or expected.
- Chargeable volume of the discharged sewage is based on the estimated daily water consumption volume.
- Tariff for each groups of users is assumed to be the same. Tariff for the first year after the project begins operation will remain at the same level for the second year, then rise in the third year by 10 percent, and continue unchanged for the fourth year. After that, tariff will be raised once every three years by 10 percent each. As a result, at the end of the first 10 year period, the total increase in the tariff will be 33 percent.
- The basis used in calculating the operating costs are as follows:
    - Costs of energy and chemicals are assumed to increase at the assumed inflation rate used in this study.

- The number of employees is assumed to stay at the same number during the entire repayment period. Although the sewage treated will increase every year, with the use of new equipment and managerial efforts, the project is assumed to be operated and managed without increasing the number of employees.
- Salaries are assumed to increase at the inflation rate used in the study. Social security cost remains at 30 percent of the wages.
- Salaries and social security of the administration and engineering sections are assumed to be shared evenly between the water supply and sewerage divisions, as it is at present.

- Depreciation is included and calculated using rates and terms in accordance with government regulations as shown below. Other initial investment fees are depreciated over 10 years after beginning operation.

Item	Rates (%)	Term (year)
Building with plant	0.025	40
Pipeline	0.025	40
Pump	0.125	8
Special equipment	0.11	9
Vehicles	0.10	10

- Maintenance includes the repairing of the equipment and vehicles, spare parts and materials needed for maintenance. The maintenance is estimated as 1.5 percent of the initial investment for pumps and equipment, and is assumed to remain at the same level during the whole term.
- Taxes include the Nature Protection Tax, Property Tax and Road Tax. Rates of these taxes are assumed to be raised once every 3 years, by 5 percent.
- Pollution charge is calculated and included as an operating cost. First, the real value of the charge is calculated from the load of pollutants. Then, the rate of the charge is assumed to be raised at the same rate as the tax.
- Other general administration fees are assumed to increase with the same rate of the sewage treatment increasing , and will rise at the same rate as the inflation rates.
- Preparing for bad receivables is included for the purpose of healthy management. It is assumed at 3 percent of the total income for the whole repayment term.
- Corporate profit tax is charged from the year of the first profit at the accumulated base, at the current tax rate of 29%.
- Average yearly working capital is assumed equal to 1.5 month of the income.
- VAT is not included. All tariffs are stated in net price.

4.12.1.2 Objectives of Financial Analysis

Objectives of the financial analysis through running the financial model are as follows:

- To calculate the tariff required to cover the operating cost and to pay back the loan (both the principal and the interests) and to make certain that a desirable level of FIRR (around 5 percent level) is maintained, for the purpose of sustainable management of the project.
- To compare among financing sources with different cost (interest rates) and to recommend the desirable financial sources that will insure an acceptable level.
- To clear some important factors of the cost control in order to carry out the project.
- To evaluate some issues influencing the financial factors and tariff in the project.

4.12.1.3 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.

4.12.1.4 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%

4.12.1.5 Effect of Foreign Exchange Fluctuation

Effect of foreign exchange fluctuation will be mainly on the financial side, if the project borrows the loan in foreign currency. Its effect on the operating side is considered minor because few items in the operating cost will be paid in foreign currency.

For the foreign loans, the Ministry of Finance may become a borrower. The Ministry will then re-lend the money to the municipality or Water Company in local currency. In such case, the foreign exchange fluctuation will have no direct effect on the project.

4.12.1.6 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.

4.12.2 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.

4.12.2.1 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.

4.12.2.2 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 1.69Lt/m^3 for Option 1 and 1.82Lt/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).

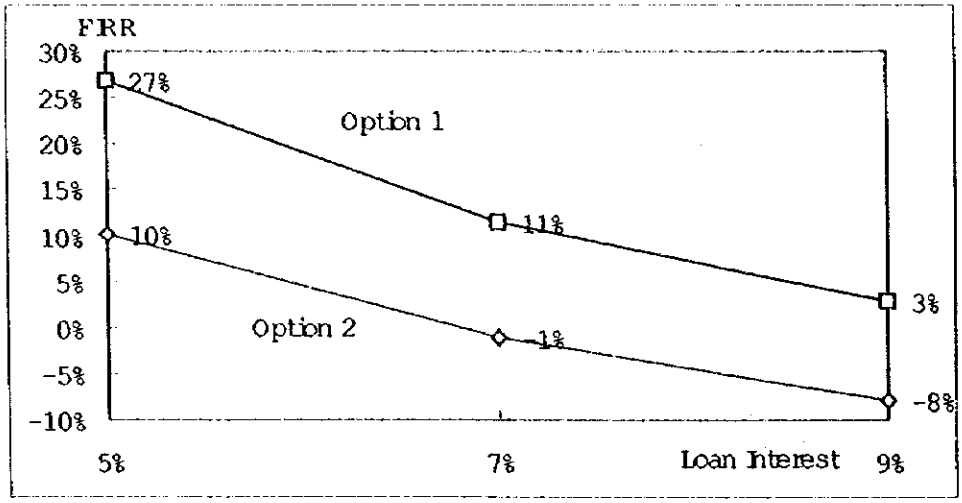
To maintain the sustainable management, some positive level of FIRR should be assumed. If the benchmark of 5 percent FIRR should be applied, the sustainable tariff is predicted at 1.74Lt/m^3 for Option 1 and 1.88Lt/m^3 for Option 2, respectively.

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.

4.12.2.3 Sensitivity Analysis

Sensitivity of the tariff projections and FIRR with different assumptions was analyzed to examine the effects of various factors.

FIRR Profile for Different Loans (cost)

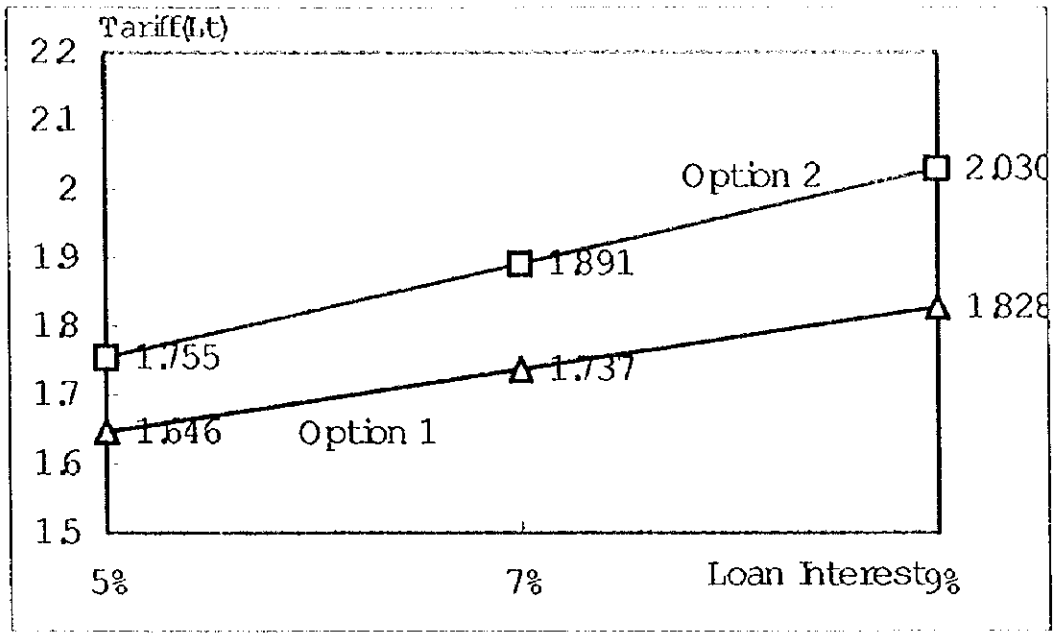


Assumption: 25year Loan with 10-year grace period for 50% of the total investment
State Grant: 50% of the total investment
Initial Tariff: 1.8Lt/m^3
Target FIRR:5 percent

Figure 4.20 Sensitivity of FIRR to Interest of Loan with Fixed Tariff

The result shows any loan with an interest cost above about 7 percent will make the project (Option 1) financially unfeasible, when the tariff is set at 1.8Lt/m^3. The loan with an interest cost of 5 percent will bring a high FIRR to the project (27 percent for Option 1 and 10 percent for Option 2).

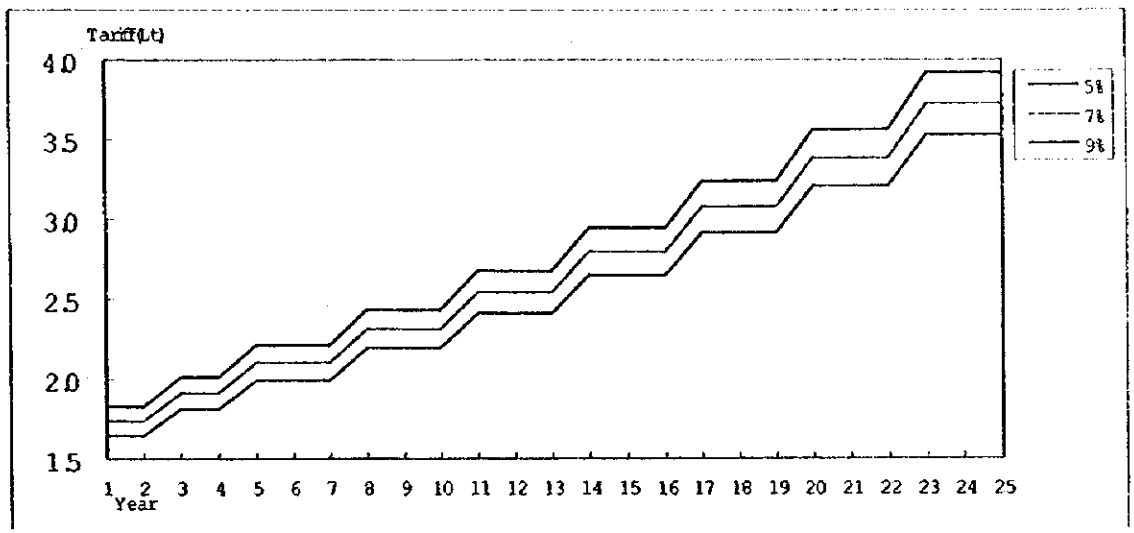
Tariff (Initial) Profile for Different Loan (cost)



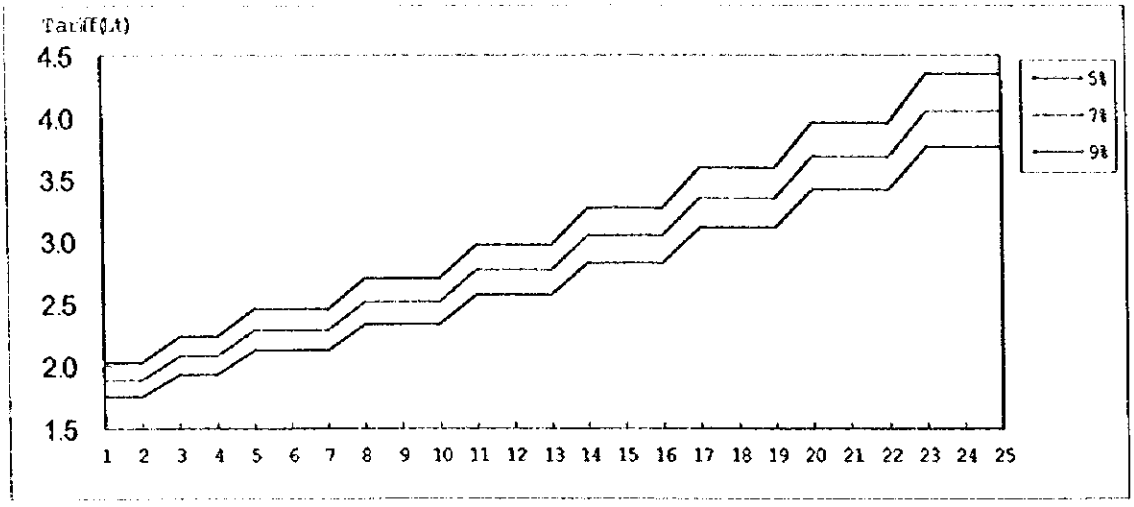
Assumption: 25year Loan with 10-year grace period for 50% of the total investment
Loan Interest: 7 percent
State Grant: 50% of the total investment
Target FIRR at 5%

Figure 4.21 Sensitivity of Tariff to Interest Rates of Loan with Fixed FIRR

Tariff Profile for different loan(cost)-Option 1



Tariff Profile for different loan(cost)-Option 2



Assumption: 25year Loan with 10-year grace period for 50% of the total investment
State Grant: 50% of the total investment
Target FIRR at 5%
In all cases, the tariffs increase at the same rate as explained in the test concerning the model

Figure 4.22 Projection of Tariff to Variable Loan Interests with Fixed FIRR

The result shows that the interest cost has a great effect on the initial tariff. The lower the interest rate is, the lower the tariff can be assumed.

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.

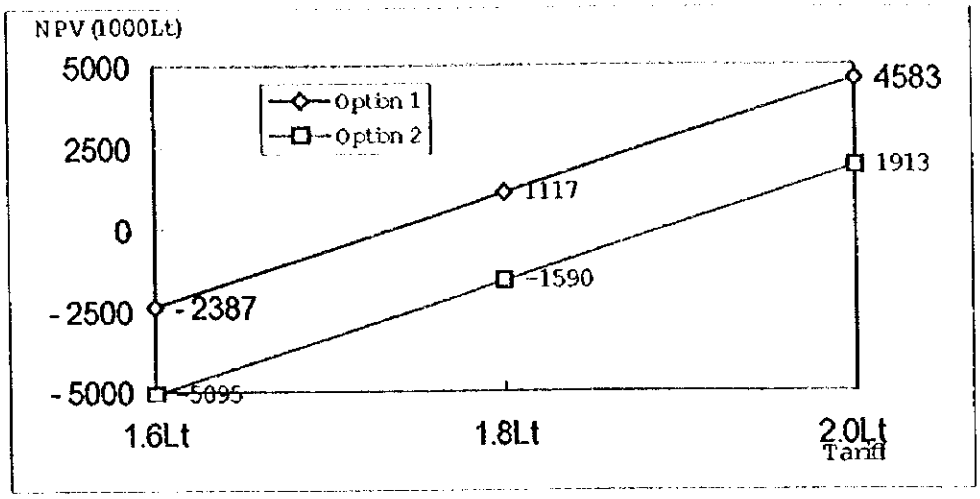
The effect on the tariff from the beginning to the end of the repayment period, of the different interest cost, are as follows:

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

Table 4.63 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

NPV(Net Present Value) Profile for Different Initial Tariff



Assumption: 25year Loan with 10-year grace period for 50% of the total investment
Loan interest: 7 percent
State Grant: 50% of the total investment
Discount Rate used calculating NPV: 5 percent

Figure 4.23 Sensitivity of NPV to Initial Tariff with Fixed Loan Interest

The result shows that in the case of utilizing the loan with 7 percent interest, the Net Present Value (NPV) of the project, using discount rate of 5 percent, at the different level of tariff are as follows.

The tariff of 1.8Lt will bring the project the positive NPV for Option 1, while bring negative NPV for Option 2.

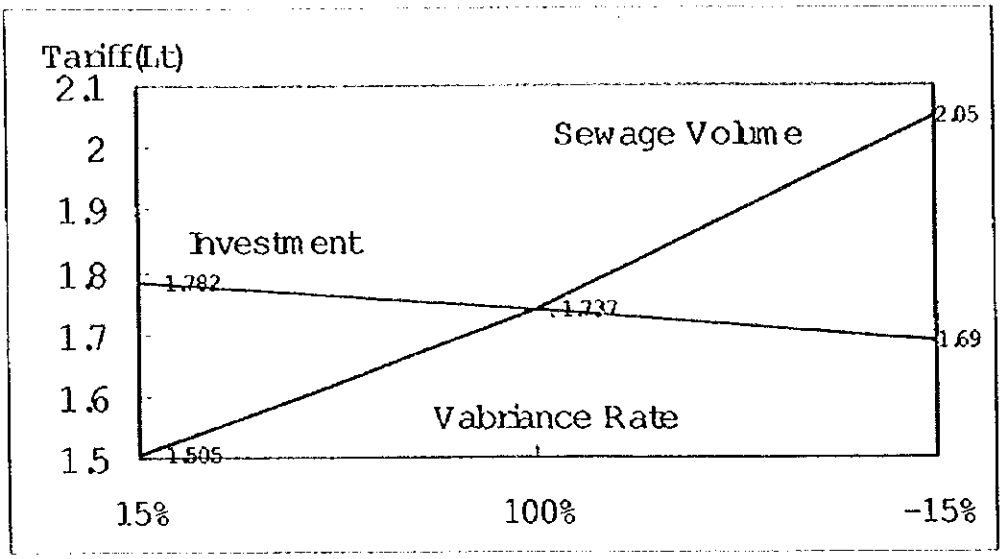
The tariff of 2.0Lt will bring the project the positive NPV for both Option 1, and Option 2.

The tariff of 1.6Lt will bring the project the negative NPV for both Option 1 and Option 2.

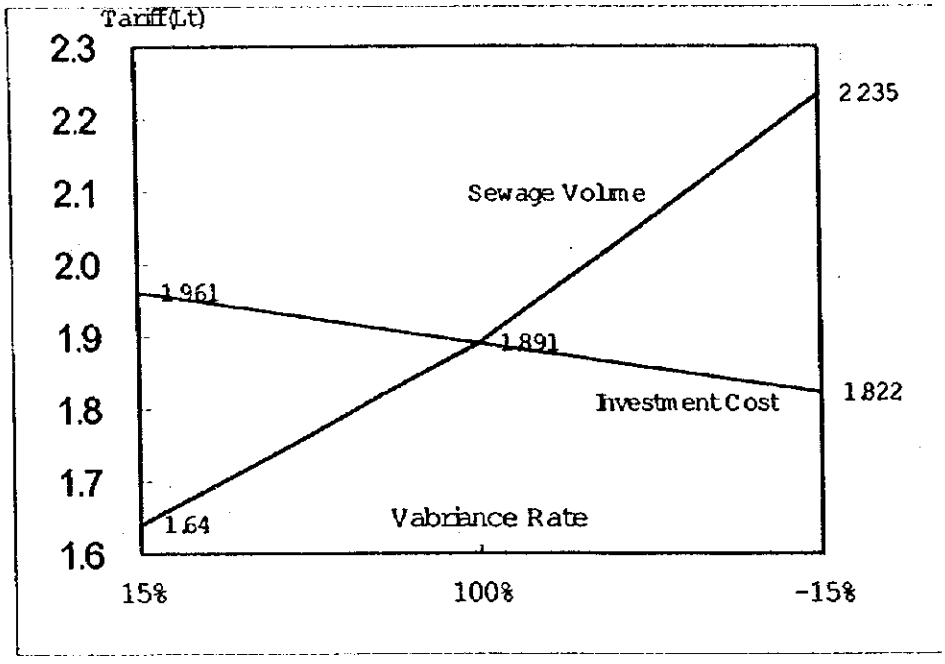
The positive NPV using discount rate of 5 percent means the project will be able to cover the operating cost and to pay back the loan (both the principal and the interest), when the total cost of the project is at or below 5 percent.

The negative NPV using discount rate of 5 percent means the project can not cover the operating cost and pay back the loan (both the principal and the interest), when the total cost of the project is at or above 5 percent.

The tariff profile for the initial investment cost and sewage volume variance (Option 1)



The tariff profile for the initial investment cost and sewage volume variance (Option 2)



Assumption: 25year Loan with 10-year grace period for 50% of the total investment
State Grant: 50% of the total investment
Interest Rate of Loan: 7%
Target FIRR at 5%

Figure 4.24 Sensitivity of Tariff to Investment Cost and Sewage Volume

Option 1

The result shows that if the initial investment cost increases by 15 percent, tariff required to achieve the FIRR 5 percent should be 1.78Lt/m^3 at the first year. If the investment cost decrease by 15percent, tariff required to achieve the FIRR 5 achieve can decrease to 1.69Lt/m^3.

If the amount of sewage decreases by 15 percent, the tariff required to achieve the FIRR 5 percent should be 2.05Lt/m^3 at the first year. If the amount of sewage increases by 15 percent, tariff required to achieve the FIRR 5 percent can be decreased to 1.51Lt/m^3.

Option 2

The result shows that if the initial investment cost increases by 15 percent, tariff required to achieve the FIRR 5 percent should be 1.96 Lt/m^3 at the first year. If the investment cost decrease by 15 percent, tariff required to achieve FIRR 5 percent can decrease to 1.82 Lt/m^3.

If the amount of sewage decreases by 15 percent, the tariff required to achieve the FIRR 5 percent should be 2.24 Lt/m^3 at the first year. If the amount of sewage increases by 15 percent, tariff required to achieve the FIRR 5 percent can be decreased to 1.64 Lt/m^3.

4.12.3 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 (1.16L.t/m^3) is at the lower level in the country, and should have 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.

4.12.4 Economic and Social Analysis

4.12.4.1 Project Benefits

The value of the project will be viewed in terms of economics as well as financial values. A sewerage project provides the community with a wide range of economic benefits such as health, sanitation and overall living conditions. The various benefits expected to be brought about by the project are discussed in the following sections.

(1) Health benefits

Health benefits are clear and one of the main reasons of installing a sewerage system. The health benefits that are brought about to the community by the sewerage system have two aspects. The first is the preventing effect that reduces the burden on the local and central governments in terms of disease prevention and patient treatment effect activity. The second is the reduction of opportunities to contact with infected matters, which reduces the incidence of diseases.

It is reported that water related diseases had been increasing from 50 cases in 1990 to 63 cases in1994. It is difficult to make causality of sewerage clearer and it is said that the number is decreasing. Health benefits may not be large in Birzai area.

(2) Environment benefits

The Birzai district is in an active karst zone. The existing wastewater treatment plant was built in 1967. The plant is overloaded and ineffective. Poorly treated water is discharged to the Tatula River and reaches the ground water.

One of the purposes of the Project is the enhancement of the living conditions in areas where water quality has been worsening. This will be achieved by the construction of this project. This project will reduce water pollution that has large impacts on living conditions. The people may be able to enjoy swimming in the river and the lakes more safely and fishes will come back into the river and the lakes.

(3) Local Economic benefits

The construction of the sewerage project will contribute to the local economy in several ways. The first is the input-output effect of construction and procurement of materials during the construction period in the regional economy. The local economy will benefit from the employment of individuals for construction work and through the sale of locally made products and services. If the Water Company uses foreign materials, the effect would decrease. The cost of the construction should also be as low as possible for healthier management. This effect should therefore not be expected too much. The second is the public revenue benefits and it is expected to increase even if the amounts are not large. The Water Company will pay more than two times today's real estate tax.

(4) International Relation Benefits

Lithuania decided to join the EU and has to build environment facilities, such as sewerage, to meet the environmental standard of the EU.

4.12.4.2 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 4.64 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	-	-	-
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

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 cannot be quantified. When economic effects of infrastructure projects are estimated, the following aspects are generally quantified. It is necessary to set simple conditions to calculate benefits.

(1) Residents

1) Amenity benefits from a healthy environment after construction of the project are difficult to calculate.

2) Health benefits from reducing water related diseases and decreases in medical expenses after construction. For example, the beneficial effects equals the reduction in the number of decreases, i.e. number of patients times average cost for medical expenses per capita)

3) Leisure benefits such as boating, swimming, fishing or picnic in a clean river and clean lake, and sightseeing after construction, for example. The beneficial effects will be equal to the number of people typically using these facilities times the average recreation expenditure per capita.

(2) The Water Company

1) Efficient management from decreased operating costs after construction, for example. The beneficial effects equal the decrease in operating costs between the old sewerage system and improved system. The told operating costs would include, for instance, clearing up after a heavy storm from overflowing sewerage systems.

2) Increase in revenue after construction, for example, the beneficial effects will be equal to the increase in revenue between the old sewerage system and improved sewerage system)

(3) Municipality

1) Adequate pollution charges. For example, the beneficial effects will be equal to the decrease in pollution charges after the new system is constructed. The beneficial effects will also be equal to the increase in pollution charges in case that the Water Company doesn't pay pollution charges due to recording loses. The beneficial effects therefore equal the absolute number of changes in pollution charges after the new system is constructed.

2) Real estate tax in case of added value and expansion of the improved treatment plant site after construction. For example, the beneficial effects will be equal to the increase in real estate tax.

(4) The Government

1) Increase in corporate tax after construction.

2) Increase in VAT gained from construction, and its second effects from purchases during construction and operation, for example, the beneficial effects equals construction costs times VAT plus second effects times VAT plus operation costs divided by 1 plus VAT.

(5) Others

1) Employment of construction workers during construction. For example, the beneficial effects equal the wages per capita times workers, equal the wages per capita times construction costs divided by labor productivity of construction worker per capita.

2) Procurement of materials and others items during construction. For example, the beneficial effects equal second effects which equal the multiplier in an input-output-table times construction costs: the multiplier in Japan ranges from 2.0 to 3.0, for instance)

3) Employment of second effects. For example, the beneficial effects equal second effects workers salary which equals wages per capita times workers number which

equals the wages per capita times second effects divided by average labor productivity per capita of all industries.

4) Attraction of new industries and employment of workers after construction, which is difficult to estimate. For example, the beneficial effects equals the construction plus its second effects plus the employment wages gained.

5) Increase in productivity of agriculture because of improvement of the soil is also difficult to estimate.

4.12.4.3 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. The public organizations or public service bodies might have to hire local people at the former Soviet Union era. This kind of custom management should be changed gradually. The company is not responsible for unemployment problems in the region. The company is responsible for efficient management and coverage of the costs as an independent organization. The municipality and the government is responsible for unemployment problems instead.

Table 4.65 Average monthly gross earnings

	1995		1996	
	Amounts (litas)	index	Amounts (litas)	index
Total	502	1.00	641	1.00
Panevėžys district	439	0.87	577	0.90
Birzai	445	0.89	581	0.91

Table 4.66 Average Annual Unemployment Rate

	1993		1994		1995		1996	
	rate	index	rate	index	rate	index	rate	index
Total	4.4	1.00	3.8	1.00	6.1	1.00	7.1	1.00
Panevėžys district	5.6	1.27	4.7	1.24	6.0	0.98	6.4	0.90
Birzai	5.6	1.27	3.6	0.95	5.0	0.82	5.1	0.72

4.13 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 4.25.

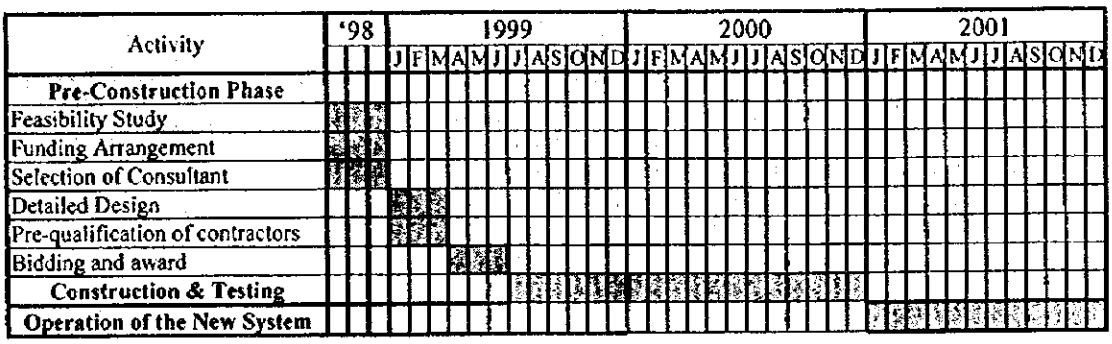


Figure 4.25 Implementation Schedule

4.14 RECOMMENDED ORGANIZATION AND MANAGEMENT OF THE WATER COMPANY

4.14.1 Recommended Organization

4.14.1.1 Changes in Organization

In order to make the tasks and roles clearer, departments controlling several business units should be established. The Water Department is in charge of water supply service consisting of an operation unit and a maintenance unit. The Sewerage Department is in charge of sewage collection and treatment and consists of an operation unit and a maintenance unit. A Controller Department should be established to strengthen the function of billing and collection. The Finance Department is in charge of bookkeeping and accounting. A Business Support Department (consisting of a technical support unit and an administration support unit) should be established to control several business units serving the water department, the sewerage department and other administration departments. All departments should have managers and all units reporting to the department should have leaders. The function of the controller in charge of billing and collection of fees will become more important in the future after installation of the new system and increased usage. Billing and collection of the fees is very much like sales of general private companies. Usually sales departments are established to increase revenue and many presidents of private companies are good salesmen. A recommended organization for the Water Company is presented in Figure 4.26.

4.14.1.2 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. The managers of two departments have the responsibility to cover the costs like the Director. The Water Company (the director and the mangers of two departments) should have discussions in setting transparent sharing ratios for all costs items once their responsibilities are defined.

4.14.1.3 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.

Table 4.67 Cost Sharing Table Form

Cost items	Sharing ratio of sewerage unit	Sharing ratio of water unit	Annual costs	Costs sharing of sewerage unit	Costs sharing of Water unit
Personnel costs Name of person					
President					
Mr. A					
Ms. B					
-					
Operation costs					
Energy					
Fuel					
Total					

4.14.2 Recommended Enforcement of Management

4.14.2.1 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.

4.14.2.2 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.

4.14.2.3 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 4.27.

4.14.3 Performance Assessment System

4.14.3.1 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.

Goals, for example, could consists of: 1) cost saving (amounts of money spent, improvement compared to the previous year), 2) efficient operation (numbers of breakdowns, improvement compared to the previous year), and 3) safe operation (numbers of accidents, improvement compared to the previous year), etc.

4.14.3.2 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.

4.14.3.3 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.

4.14.4 Other Issues in Organization and Management

4.14.4.1 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.

4.14.4.2 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 4.28.

4.15 PROJECT EVALUATION

4.15.1 Rationale of the Project Implementation

Groundwater in the karst area around Birzai currently faces the danger of pollution while the groundwater is vulnerable due to low subterranean flows. From the viewpoint of preservation of groundwater quality in the karst area, the Tatula River is designated as a protective area in the National Environmental Action Program. As sewage continues to be discharged from Birzai Town and disposed of into the Tatula River without proper treatment, immediate improvement should be carried out to prevent pollution of the groundwater.

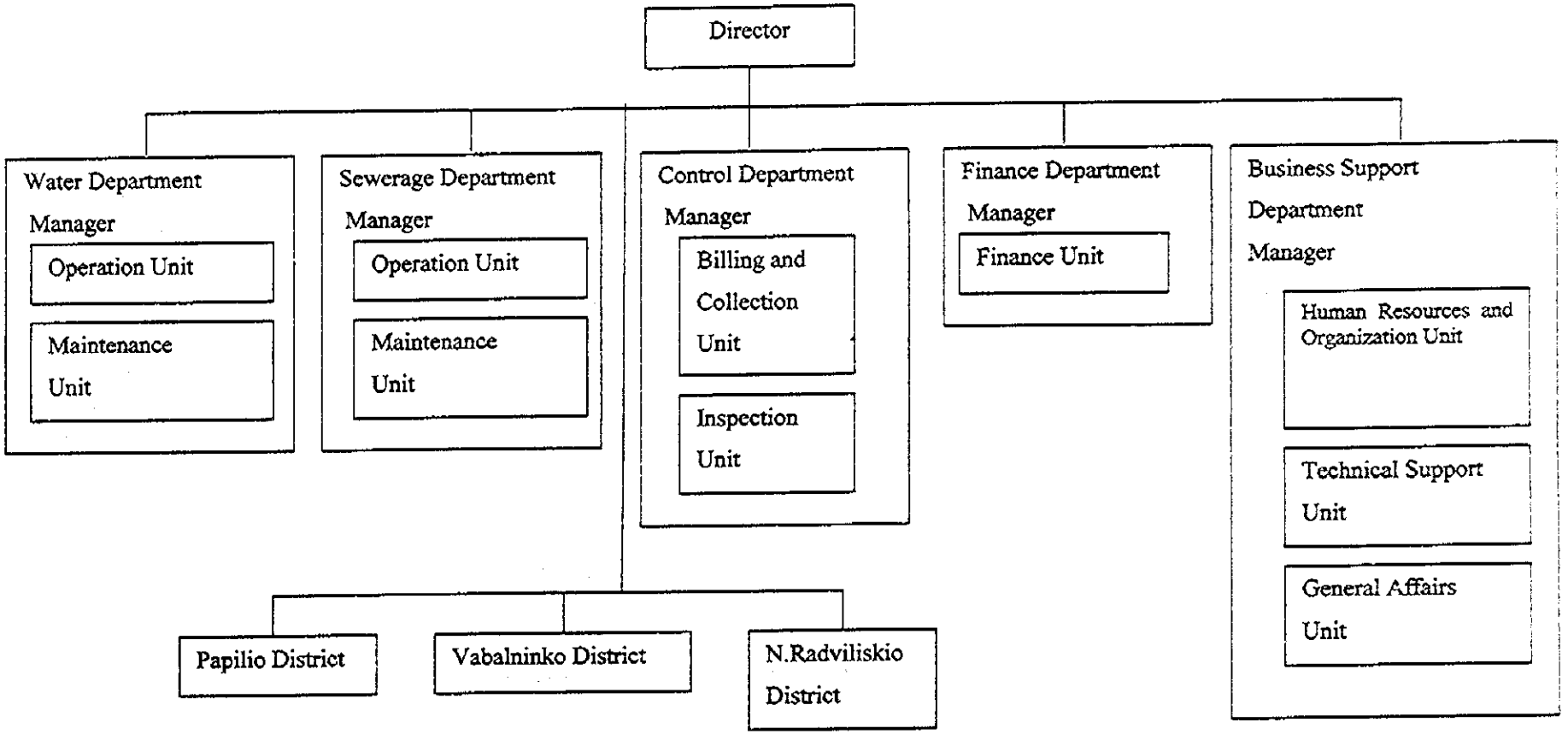


Figure 4.26 Recommended Organization for the Birzai Water Company

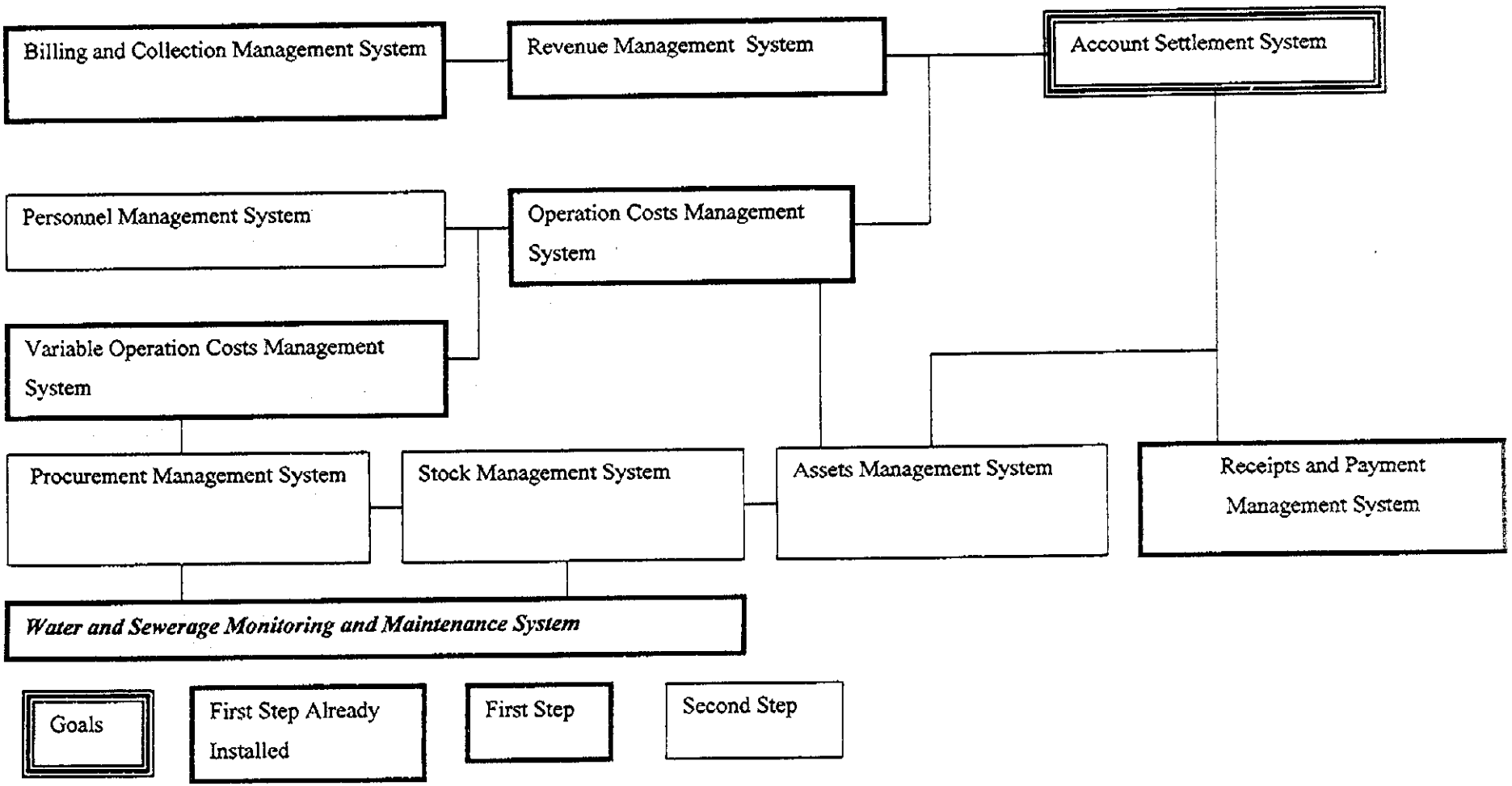


Figure 4.27 Recommended Information Management System

As discussed in the previous sections, the proposed treatment process with tertiary treatment and discharge to the Juodupe River is the recommended scheme if the Water Company considers this to be technically and economically feasible.

Secondary treatment and discharge to the Obelaukias River is however proposed as an alternative if the operation of the tertiary treatment is considered inappropriate.

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.

4.15.2 Project Evaluation

4.15.2.1 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.

4.15.2.2 Environmental Consideration

Implementation of the proposed project will lead to improvement of the existing environmental pollution caused by the discharge of the effluent from the sewage treatment plant. Adverse impact on the Tatula River basin will be substantially reduced by introducing the recommended treatment method and by properly carrying out the treatment operation. The karst area environment downstream of the Tatula River is expected to improve.

The sewerage service ratio is scheduled to increase from the present 50 percent to 70 percent in 2010. With more houses connected to the sewerage system, the proposed project will reduce the amount of domestic wastewater that is currently discharged into the drainage channel and finally flowing into the Sirvenos Lake. Effort to reduce the pollution load discharged into the Sirvenos Lake is necessary since the water quality of the lake will worsen if pollution loads increase.

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

4.15.2.3 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.

4.15.2.4 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.

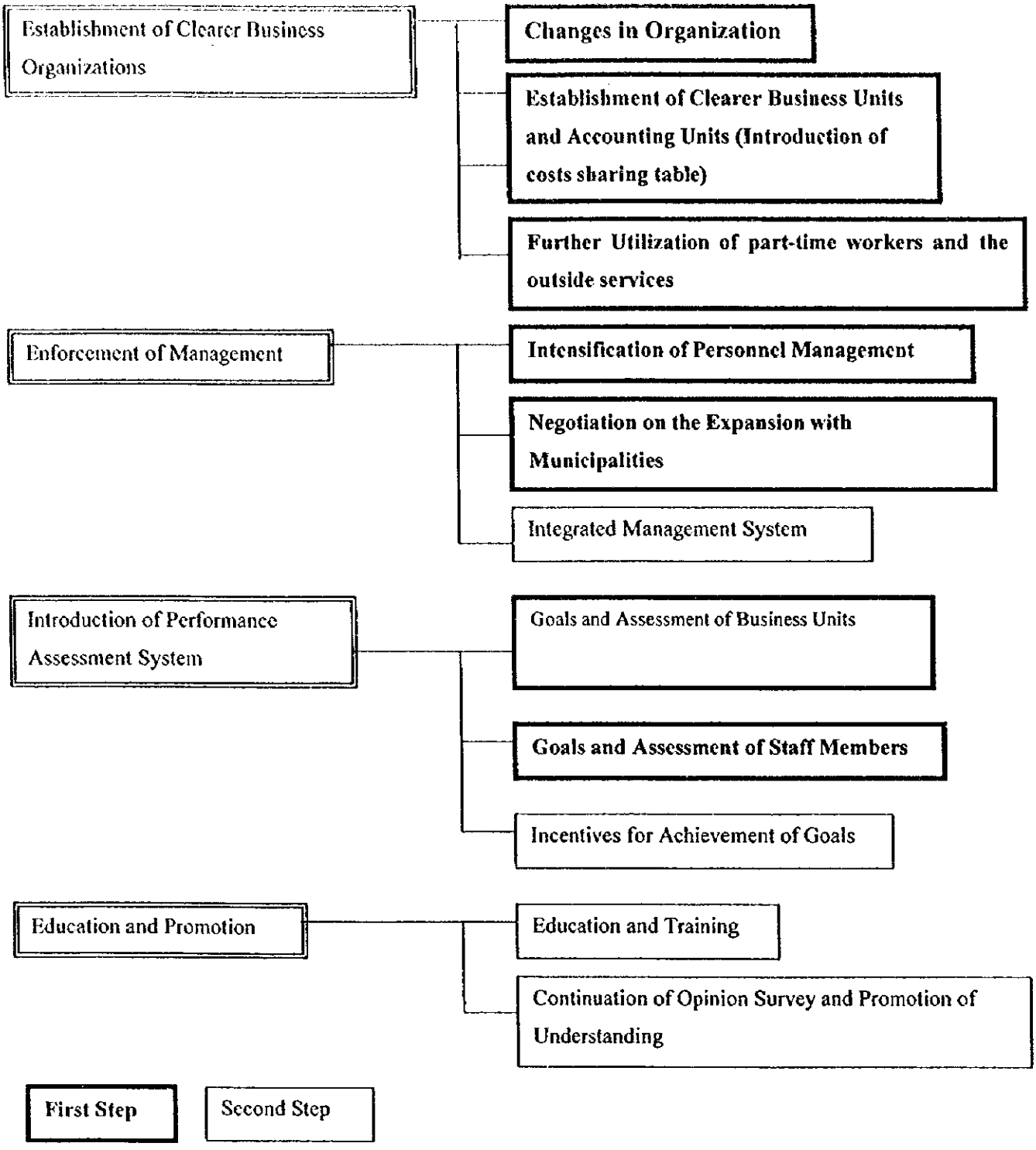


Figure 4.28 Recommended Program Structure for the Birzai Water Company

CHAPTER 5

ENVIRONMENTAL IMPACT ASSESSMENT

5 ENVIRONMENTAL IMPACT ASSESSMENT

5.1 IDENTIFICATION OF ENVIRONMENTAL IMPACTS

5.1.1 Major Findings of the Preliminary Environmental Study

5.1.1.1 General

The JICA preliminary study mission arrived in Lithuania during November 1997 and carried out a preliminary environmental impact assessment (EIA). The preliminary EIA identified some items with probable adverse impacts and concluded that the project required an EIA.

The JICA study team arrived in May 1998, and reviewed the preliminary EIA after a period of field reconnaissance and data collection. The study team also conducted screening and scoping sessions for the following reasons:

(a) The preliminary EIA is appropriate in general, however there are many points which seem to be insufficient or not always appropriate. It is quite reasonable that there are some differences in the EIA between the preliminary mission and the study team as the survey period for the preliminary mission was too short to collect all necessary data and information.

(b) The preliminary EIA report was written only in Japanese. It is now necessary to present the results of this comprehensive EIA in English for review by the Lithuanian side.

Accordingly, the screening and scoping presented herein are based on the information and data collected during this study period.

5.1.1.2 Screening

The objective of screening is to determine if the project requires an environmental impact assessment.

Features of the project and its environment are summarized in Table 5.1 and Table 5.2 for a brief understanding of the project from the screening stage. The results of screening are shown in Table 5.3. The environmental components are categorized and selected to cover all probable cases. All the general components are included in the list, although the sewerage projects may, in general, have impacts on some limited components such as the relocation of inhabitants, waste sludge treatment, fauna and flora, landscape, water pollution, noise and vibration, and odor.

It is concluded that an EIA is necessary.

5.1.1.3 Scoping

Objective of scoping is to find significant impacts among all probable impacts for the projects and to clarify the significant fields or components for the EIA survey. The checklists for

scoping is shown in Table 5.4. The overall evaluations of the unknown, slight or significant environmental impacts are shown in Table 5.5.

The components selected by the preliminary mission are all included in the list impacts, although a few of them are not considered significant.

5.1.2 Components of EIA

Based on the results of the study conducted by the JICA preliminary mission and also referring to discussions with the Lithuanian side, the objective components of an EIA are selected as follows:

Item	Related Issues in the Project
(a) Relocation (and land acquisition)	Relocation of inhabitants in or near the construction site, land acquisition and compensation
(b) Vested Right	Water use right including any permission or customary use
(c) Health and hygiene	Contaminated water for drinking water source, sludge treatment/disposal
(d) Waste disposal	Sludge treatment/disposal
(e) Topography and geology	Change of natural topographic condition Change of geological conditions
(f) Groundwater	Contamination of groundwater
(g) River and lake	Changes caused by water quality pollution
(h) Fauna and flora	Conservation of significant or endangered species
(i) Landscape	Landscape of project facilities in harmony with the surrounding area
(j) Water pollution	Water quality deterioration of river water, groundwater and lake water due to effluent disposal from the STP
(k) Soil pollution	Soil contamination by effluent disposal from the STP and sludge disposal or storage
(l) Odor problem	Odor from the STP and sludge disposal site

5.2 ENVIRONMENTAL IMPACT ASSESSMENT

5.2.1 General

Environmental assessment is all about comparisons. The EIA is fundamentally a study to identify what is existing and to predict what changes will result from the project. Accordingly, the EIA only needs to compare the existing environment against the anticipated changes.

If the present environment is already polluted, the project does not have a responsibility to improve the condition to a level within the desirable environmental condition. It does not mean that the project makes an adverse impact, as long as the environment is no worse on completion of the project than prior to the project.

The components included in the EIA are selected from the preliminary environmental study. The same categories of component are to be used for the EIA, although there are some common impacts among the various components.

In this report, the baseline data for the EIA is not attached, except for some selected items. It is necessary to refer to the supporting report of the EIA for more detailed and background information.

5.2.2 EIA for the Project in Birzai

5.2.2.1 Environmental Impact Assessment

(1) Impact on Relocation (and Land Acquisition)

There is no one living at, or using the area near, the proposed STP site owned by the state. The surrounding area is used primarily for grazing or agricultural farming. Accordingly, no relocation is required for construction of the STP.

The connection pipeline between the existing system and the proposed new STP site was almost completed before suspension of construction. The probable issue will only be for the route of an effluent discharge pipe from the STP.

There are four alternative locations for discharge of effluent as follows:

(a) Juodupe river
(b) Agluona river
(c) Apascia river
(d) Obelaukias river

As of the middle of September 1998, a conclusion has not been reached although it appears that disposal of treated effluent will be to the Juodupe River. The environmental impacts on the relocation and land acquisition of the four alternative cases are predicted as follows:

(a) Juodupe River

The new effluent discharge pipeline from the proposed STP will be connected to the existing effluent discharge pipeline from the existing STP. The new pipeline is 2.0 km

long and passes through agricultural land or grassland. There will be no impact on relocation, as the area is non-residential and it is possible to take a detour route on the way, if necessary. Concerning land acquisition, it was determined that the majority of this route may be private lands. However, a survey has not yet been made. Land acquisition may not be a concern for the following reasons:

- Land acquisition is required only for a strip of a farmland and it is possible to select a route along the edges of farmland, so that no significant inconvenience to agricultural activity is expected.
- Owners do not usually object to land acquisition for this kind of public works.
- The land price will be low because it is not intensively used. Budget preparation for the land acquisition should not be a problem.

The above comments, however, are subject to review based on a field survey, which will be necessary, when the pipeline route is definitely decided.

(b) Agluona River

There is a tributary of the Agluona River very near the proposed STP site. Only 50 to 100 m pipeline or canal is necessary to drain the treated effluent to the tributary. It is less than 500 m if discharge to the main stream is required. There will be no impact on relocation. Land acquisition would not be necessary.

(c) Apascia River

Approx. 2.5 km of pipeline is necessary to dispose of the treated effluent to the Apascia River. There are some houses located along the way, although the land is primarily agricultural. There will be no impact on relocation. Land acquisition is not necessary as the pipeline could follow existing roads. The land acquisition is almost guaranteed, as the route to the Apascia River is a part of the proposed pipeline route to the Obelaukias River.

(c) Obelaukias River

Approx. 7.5 km of pipeline is necessary to drain the treated effluent to the Obelaukias River. There are some houses located along the way, although the land is used for agricultural. There will be, however, no impact on relocation. The route to the Obelaukias River was planned several years ago and agreements were made between the private landowners and the Water Company for land acquisition when necessary, according to the information from the Water Company. However, payment to the owners has not yet been made.

Accordingly, if the Juodupe River is selected as the river to receive effluent, no adverse impact is predicted. It would be necessary to verify land acquisition for the discharge pipeline route before construction.

(2) Impact on Vested Right (on Water)

As far as the information obtained verifies, there is no official vested right to guarantee a certain quantity or quality of natural waters. There is a government regulation requiring permission for water intake, utilization and transmission and discharge of pollutants to natural waters. This permission, however, does not always mean a vested right on water use. It can be said that no impact may arise on vested right, however it would be better to consider that the permission is also a type of vested right.

Detailed data on the present permissions to use the natural water were not obtained. It seems that there is no remarkable water use other than recreational use of the lake which receives flow from the Agluona and Apascia Rivers for boating and fishing. Some factories take water from underground. From the rivers, the water is taken only for agricultural use but the quantity is not large. The agricultural farming in this region generally does not require irrigation since rainfed farming is common. Therefor, no impact may arise on water right from the quantitative point of view.

The proposed project will not take water from the natural source, but discharge the treated effluent to a river. Accordingly, the consideration has to be made to the water quality of rivers and groundwater. The right for water use may therefore be hindered if the water is contaminated from the qualitative point of view.

There are four alternative rivers to discharge the treated effluent. The environmental impacts on the water right in connection with the water quality of the four alternative cases are described as follows:

(a) Juodupe River

The Juodupe River is a tributary of the Tatula River. Both rivers are already seriously polluted downstream of the discharge point of the existing STP. The existing plant does not have sufficient capacity or the ability to meet the discharge regulations. The water quality of these rivers will be improved after the new plant starts operation. No adverse impact is expected.

(b) Agluona River and Apascia River

The Agluona and Apscia Rivers are not clean but generally not polluted from sewage. The annual mean discharge is approximately 0.44 m^3/s in the Agluona River and approximately 4.21 m^3/s in the Apascia River at the flow measurement stations of the MOE. In this case, the flow measurement station is located in the downstream stretch of the river and the catchment area of the Apascia River includes Sirvenos Lake. If effluent is discharged into one of these rivers, the river water will be more or less contaminated although the contamination may be within an acceptable level due to the dilution of the effluent, which is treated to the level of required standard. It is, however, not desirable to discharge the effluent at the upstream side of the lake and

town area where people sometimes enjoy boating, fishing and occasionally swimming. The use for recreation may not be a vested right but must be considered as a public right.

(c) Obelaukias River

The Obelaukias River (or better to call a "canal" or "rivulet") is not a clean river, but generally is not polluted. The annual mean discharge is not known but is estimated at less than 0.1 m^3/s. If the effluent is discharged into the river, the river water will be more or less contaminated. Although the contamination may be within an acceptable level, the dilution of the effluent is not so effective because of the low rate of flow.

As explained above, no adverse impact in vested rights is predicted. It would be, however, necessary to verify the vested rights in the Juodupe and Tatula Rivers and the Latvian rights.

(3) Impact on Health and Hygiene

The effluent water quality from the proposed STP will be improved from the present conditions with the existing STP facilities. As explained in the previous impact component, the river water will be slightly contaminated in the Agluona, Apascia and Obelaukias Rivers compared with the present condition. Although, it may not reach a serious level and no drinking water is taken from these rivers.

Attention should be paid on the impact to groundwater. As the project site is located within the active karst area, contaminated water may infiltrate into underground, which is the source of drinking water as well as used in factory production. It is not a consideration that the groundwater may be contaminated due only to the effluent water. It would be probable that the contaminated water may infiltrate into a local groundwater source, although this would be rare.

Basically, no adverse impact may happen to the health and hygiene component. The regular inspection and monitoring of the wastewater discharge and water quality will be required to verify the continued safety.

(4) Impact on Waste Disposal

From the project facilities, sludge treatment may be the matter of attention. Gravity thickening and mechanical dewatering using a centrifuge can dry the excess sludge. The Water Company intends to transport the dried sludge to a private firm that owns a composing machine with sufficient capacity to treat the sludge discharged at the STP. After composting, sludge may be used for agriculture or as a low-level fertilizer in re-forestation or planting of trees. The sludge from the existing STP is presently not used by farmers because it is raw primary sludge.

(5) Impact on Topography and Geology

No significant change in landform is made by the proposed project although the inlet is

raised above the existing ground by 6 m to allow gravity flow through the plant. The soil used to raise the inlet will originate from the excavation for the structures. The project site is located in a flat land. There is no adverse impact concerning the topography.

Impact on geology may need to be considered. The project site is located in an active karst area where sink holes may develop if treated effluent water infiltrates into a sensitive area. The general location of gypsum karst area in north Lithuania is shown in Figure 5.1. The location map of karst in the Birzai area is shown in Figure 5.2.

The treated effluent will be better than the water quality standard allowed for discharge of sewage. Contamination will also be low. The adverse impact to the geological component may not happen, if the project facilities are well maintained. It would be, however, necessary to monitor the geological conditions surrounding the STP site but also along the discharge pipeline route.

(6) Impact on Groundwater

This item is the similar issue as already described in the items of "health and hygiene" and "topography and geology". There is a possibility of groundwater contamination, although such case may only occur when the project facilities are not well maintained. If there is infiltration of contaminated water into the ground, it will cause the acceleration of karst activity and pollution. Consequently, the contamination of drinking and industrial water may happen, as their source is the groundwater.

It is noteworthy that the runoff rate from precipitation into the rivers is low in the Birzai area according to the long-term meteorological and hydrological records. The runoff rate is 28 percent to the Agluona River, 37 percent to the Apascia River and 35 percent to the Tatula River while in case of the Bartuva River in Skuodas, the rate is 56 percent. The remaining balance evaporates, is taken up by plants, or infiltrates into the ground. Although there is no definite data about infiltration, it is almost certain that the infiltration rate in Birzai is much higher than that in Skuodas. It seems that there is no relationship to the karst form in regard to the rate of infiltration into the groundwater.

The treated effluent will be better than the water quality required for sewage discharge and the contamination level is low. The adverse impact may therefor not happen to the groundwater component, if the project facilities are well maintained. It would be, however, necessary to monitor the groundwater quality of the surrounding area of the STP site but also along the effluent discharge pipeline route.

(7) Impact on Rivers and Lakes

The major project facilities are not located in or along any river or lakes, so no direct impact is predicted from construction or from long-term operations. The effluent pipeline will however discharge into a river which will be affected by construction and long-term point discharge. The river system and lakes in and around Birzai are shown in Figure 5.3.

The only concern will be an impact related to water quality. If the effluent from the treatment plant contaminates the water, it will cause water pollution. River waters will then become inappropriate for recreational use and some fish and animal species living in and along the river or lake could be endangered. Eutrophication may occur in case of a lake, however, as discussed in the later part for water quality, the possibility of water contamination caused by the project is low. If the effluent from the existing treatment plant will be replaced with the effluent from the proposed plant, the water quality in the Judupe River would be remarkably improved from the present condition; therefore, no adverse impact is expected. In case of the three other rivers, the water will be slightly contaminated due to the effluent in comparison with the present conditions; but again, no adverse impact is expected. The contamination may be so minor that no change in the natural condition are expected.

An adverse impact to the rivers and lake(s) would not be the result from this project. It is, however, required to monitor any change in conditions in the rivers or the lakes during the operation and maintenance period.

(8) Impact on Fauna & Flora

There is no significant or endangered species in or around the STP site. There may be, however, significant species in the river into which the treated effluent will be discharged. Attention must be paid to the life in and along these rivers and/or lake.

There are four alternative rivers which could serve as a discharge point for the treated water. In the case of the Juodupe River (a tributary of the Tatula), some comments are presented as follows:

(a) In the initial stages of study, there may be some misunderstanding that the effluent is directly discharged into the Tatula River. The treated effluent from the existing STP is actually discharged into the Juodupe River through a pipeline of approximately 2 km long, at about 4.5 km upstream from the confluence to the Tatula River. The heavily contaminated water from the existing treatment plant is therefore considerably diluted when the Juodupe River joins the Tatula River, although the water is still contaminated.

(b) The Tatula is, of course, a significant river from the viewpoint of environmental protection; however, the Apascia and Agluona Rivers are also significant. These three rivers are all listed in the non-leasable rivers of state value approved by Resolution No.172 of the Lithuanian government in 1995. These three rivers have animals, such as otter and beaver, protected under the Bern Convention

(c) In other words, the Tatula River as well as the Juodupe River is not a special one among the rivers concerned in regards to the flora and fauna component.

Among the four rivers, the Apascia and Tatula Rivers are also listed as rivers for

reproduction of vimba (fish).

If effluent is discharged into the Juodupe River, the water quality will be improved after the new STP is in operation and there is little possibility from an adverse impact on the fauna and flora. The water in the Judupe River will be improved because of low contamination in the treated effluent and natural dilution in the river.

In the two other rivers, the water quality is expected to become only slightly worse compared with the present conditions. The water quality in these rivers, however, may be considered as basically not changed from the present condition due to the well treated effluent discharge and natural dilution in the river. Accordingly, the impact to fauna and flora in the rivers may be negligible. In addition, there are generally no animals living downstream of the prospective discharge points in the Apascia and Agluona Rivers. The Obelaukias River is a small rivulet and is located outside of the town area. No significant life is expected in the river.

In case effluent is discharged to the Apascia and Agluona Rivers, the impact on life in Sirvenos Lake has to be considered. Eutrophication is possible if the quality of the effluent worsens due to poor maintenance of the facilities in the future. If the lake suffers from eutrophication, it leads to an abnormal high production of algae that will then decompose. This process may cause serious damage to life in the lake. It is difficult to recover to the original condition. Accordingly, it is not recommended that treated effluent be discharged to either the Apascia or Agluona Rivers.

In general, there may be no serious adverse impact to fauna and flora as long as the STP is well operated. It is however recommended that a survey be conducted of the fauna and flora regularly to monitor any change in the river life after receiving effluent.

(9) Impact on Landscape

The STP is the main facility of the project and located in a rural area, approximately 2 km away from the center of town. Grazing and agricultural fields surround the site. No houses or buildings are located nearby. About 1km away, a comparatively large canned-food factory is located. The site is not significant from a landscape viewpoint. The STP site is located in neither a national nor a regional park. Although Birzai Regional Park is located nearby as shown in Figure 5.4, no particular impact is expected to happen to the park from this project. The pipeline routes also do not pass significant areas of landscape.

Accordingly, no adverse impact is anticipated on the landscape component. It is, however, recommended to architecturally design the structures and to landscape the site in harmony with the surrounding area.

(10) Impact on Water Pollution

Because the project aims at the improvement of sewage discharge by improvement in sewage treatment, adverse impacts may not be anticipated. Concerning the impact on river

water quality, an explanation has already been made in the components of "vested right", "topography and geology", "groundwater" and "river and lake". Some important points are summarized as follows:

(a) If the effluent is discharged into the Juodupe River, the water quality will be improved from the present condition, therefore, no adverse impact is expected.

(b) While in case of the three other rivers, the water quality may become slightly worse from the effluent in comparison with the present conditions. Contamination will not be serious and no change in the natural conditions are expected.

(c) In case of the Agluona and Apascia Rivers, eutrophication could occur in the Sirvenos Lake if contaminated water unexpectedly enters the lake due to poor operation of the STP. However, the possibility of such water contamination caused by the project is considered low.

On the other hand, there is a possibility of groundwater contamination, although such a case may happen only when the project facilities are not well maintained. If there is infiltration of contaminated water into the ground, it will cause an acceleration of the karst activity and consequently contaminate the groundwater. As long as the treated effluent is better than the allowable water quality standards, the contamination level should be low.

Adverse impacts on water quality may not happen as a result of construction of the project. However, it is required to monitor changes in water quality conditions in the rivers, lake and groundwater during the operation and maintenance period.

(11) Impact on Soil Contamination

Soil contamination might happen when heavily contaminated effluent, sludge or hazardous substances run-off are dispersed into the soil. In case of this project, effluent from the STP will be better than the level of the effluent standard. The sludge from the STP will be transported from the STP for composting while drying will take place in a concrete lined storage area. Accordingly, no adverse impact on soil contamination is anticipated.

(12) Impact of Odor

Odor is one of the significant issues in sewage treatment. Odors from the STP will surely be emitted. The point is how strong, how often it may happen, and how wide an area it affects. The STP site is located in a rural area surrounded by agricultural and grassland. No houses are located near the site. Accordingly, no serious impact from odor is expected. However, it will be necessary to consider the working conditions for employees of the plant and visitors. From visiting existing treatment plants in Lithuania, the odor is stronger at locations close to the treatment basins in the STP. However, the odor is much weaker at distances from its source.

In Lithuania and especially in rural towns or villages, the odor from the STP may not be an adverse issue.

In major developed countries, the odor has a much more sensitive impact for the nearby inhabitants. The odor is not only uncomfortable but also a cause of some indirect problems. For example, the value of properties can decline, in such places. Accordingly, odor reducing facilities may have to be provided in many plants, especially in densely populated areas. However, these facilities are costly in construction and maintenance. In addition, there are still comparatively large areas available for use in Lithuania especially in rural region such as Birzai and Skuodas, so that a buffer zone around the plant can be maintained, if necessary to reduce orders. This purchase of land area, larger than required just for the plant facilities, may be less costly than the provision of odor reducing facilities. Therefore such odor reducing facilities are generally not appropriate in Lithuania.

It is recommended, however, that the monitoring of odor be carried out to verify actual conditions.

5.2.2.2 Summary of EIA and Mitigation Measures

(1) Summary of EIA

The EIA carried out in the previous section concluded that there might be no component having any significant impact. The conclusion of the EIA on every component is briefly shown in Table 5.6. In a final assessment of the environmental impact, the impact level is categorized as follows:

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

The category D, "Almost no impact anticipated" is divided into D1, D2, and D3. It would be reasonable to make such division because, in some cases, a component categorized as D needs to confirm an issue or to monitor actual conditions during the operation and maintenance stage.

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.

(2) Mitigation Measures

Mitigation measures need to be adopted into the final project plan, to either moderate or forestall potential any environmental impacts. Mitigation measures generally consider the following:

(a) Changing the project site, layout, transport routes, disposal routes or locations, timing, or engineering designs;

(b) Introducing pollution controls, waste treatment, phased implementation and construction, engineering measures, monitoring, landscaping or social services;

(c) Compensation for loss or damages and/or resettlement.

In defining the mitigation measures, it is essential to make clear links with the project activities and effects. Rather than simply detailing the measures that must be taken, the EIA should define the project activities, the effect arising from that activity, and the specific measures designed to mitigate the effect. In this way, residual impact and effects that will not be mitigated, will be identified clearly.

However, as explained in the previous sub-section (1), no adverse impact is anticipated at this stage in the study. Accordingly, no mitigation measures will be required.

The EIA, however, is only a result of prediction. It will be necessary to make a survey to verify the prediction of an impact before construction, and/ or to continue the monitoring survey during the operation period.

The necessary activities for verification as well as monitoring are already shown in the previous sections of the EIA and in Table 5.6. The results, however, are summarized below:

(a) Verification of land acquisition especially the area along the effluent pipeline from the STP;
(b) Verification of vested right in the Juodupe and Tatula Rivers and in Latvia;
(c) Verification of landscape activity at the STP site, especially, during the design period;
(d) Monitoring water quality in the Juodupe and Tatula Rivers, and groundwater in and around the project site;
(e) Monitoring sludge disposal conditions including the location and method;
(f) Monitoring the geological and groundwater conditions (in the karst area);
(g) Survey and monitoring of fauna and flora in and along Juodupe and Tatula rivers;
(h) Monitoring the actual condition of odor at the STP site and waste sludge disposal site.

It is noted that the EIA was conducted without classification of project stage. It means that no separate EIA is carried out for the pre-construction and post-construction stages. The site is located in a rural area and no significant environmental restriction is foreseen for construction. There is no particular reason to make such a detailed classification for this project.

Among the selected environmental components, the relocation of residents and land acquisition is a matter for the pre-construction stage. The other components are basically a matter of post-construction stage. For the construction stage, it would be sufficient treatment plant take the usual concern for the environment. Examples of such cares or mitigation are listed as a reference as follows:

(a) Employment of local labor where possible to prevent social conflict;
(b) Safety and health control should be strictly followed;
(c) Land clearing should be minimized for access roads;
(d) Non-toxic chemicals should be used for construction especially in the drilling of deep wells.
(e) Waste (solid and/or liquid) disposal anticipated during construction should be carried out in accordance with the planning and schedule approved by the supervising engineer (burial, burn, hauling away, etc.)

5.3 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. General recommendations for management are briefly described for Birzai as follows:

(a) Establish a program for surveying and monitoring the environmental conditions of all the necessary sectors as listed below:
   - Verification of land acquisition especially the area along the effluent pipeline from the STP;
   - Verification of vested right in the Juodupe and Tatula Rivers;
   - Verification of landscape at the STP sites especially during the design phase;
   - Monitoring water quality in the Juodupe and Tatula Rivers, and groundwater in and around the project site;
   - Monitoring sludge disposal conditions including the location and method;
   - Monitoring the geological and groundwater conditions (in the karst zone);
   - Survey and monitoring of fauna and flora in and along the Juodupe and Tatula Rivers; and
   - Monitoring actual conditions of odor at the STP and waste sludge disposal site.

(b) Follow up based upon the results of monitoring and the survey and to take countermeasures, if necessary;

(c) Identify pollution sources, draw up the inventories of the pollution sources, and establish early warning and alarm procedures for reducing the pollutants discharged;

(d) Submit the records of environmental conditions (water quality, fauna and flora, odor, etc.) to the MOE for their review, when any change occurs;

(e) Prepare a plan and take measures for any wastewater sources that are not connected to the sewerage system of the project;

(f) Prepare a sufficient annual budget for environmental management;

(g) Invite school children and students to the project facilities and educate them in the importance of environmental protection and conservation;

(h) Regulate the use of the areas surrounding the STP sites;

(i) Carry out regular inspections of the facilities not only at the STP but also along the pipeline routes.

Recommendation to the MOE

(j) Prepare and ratify the bilateral agreement with Latvia on the environmental protection of trans-boundary waters and the international boundary zone.

(k) Complete the preparation or revise the necessary environmental standards (especially for water quality) as well as the definite guideline for an EIA (for individual sectors) as early as possible. For example, the effluent standards for discharge into surface waters was revised and approved in 1997, but no other standards have been updated. In addition, it is suggested to prepare detailed effluent standards for major pollution sources, especially for industries (with classification).

Table 5.1 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 5.2 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 5.3 Screening

		Item	Description	Impact	Remarks
Social Environment	1	Relocation	Relocation due to land acquisition.	Not sure	No inhabitant at the plant area. Pipeline is in private land.
	2	Economic activity	Decrease of production. Change of economic structure.	No	State land and not used at present.
	3	Traffic/Public facilities	Traffic congestion, Accident, Effect on public facilities	No	No particular increase. Only rural roads.
	4	Division of Communities	Separation of local communities due to blocking of transportation system.	No	Not applicable
	5	Archaeological/ Cultural Heritage	Decrease or deterioration of archaeological/cultural sites.	No	No such sites.
	6	Vested Right	Right for fishery, water use, logging ,etc.	Yes	No impact in quantity. But, water contamination may cause water use problem.
	7	Health and Hygene	Degradation of hygienic conditions caused by waste disposal and vector insects.	Not sure	Depending on the disposal of wastes. Contamination of groundwater from effluent disposal is possible.
	8	Waste Disposal	Construction waste/debris, contaminated mud, sludge, general wastes, etc.	Yes	Sludge disposal is a common environmental issue for sewerage project.
	9	Disaster/Accident	Increase of danger from ground collapse, land sliding, traffic accident, etc.	No	No such danger is worth consideration from the viewpoint of small scale of structures and topographic condition.
Natural Environment	10	Topography & Geology	Change of significant land forms and geological features caused by earthwork, etc.	Not sure	The site is flat land. However, care must be taken to prevent an impact to underground karst zone.
	11	Soil erosion	Soil erosion originated by runoff through earthworks, logging , etc.	No	The rainfall intensity is low. No remarkable scale of earthworks.
	12	Groundwater	Water contamination caused by excessive pumping, decreasing seepage capacity, etc.	Yes	Depending on the disposal of wastes and contamination of groundwater from effluent disposal. High infiltration in karst area.
	13	River & Lake	Change of discharge, velocity, riverbed due to reclamation, new channel construction , etc.	Yes	Probable impacts due to effluent disposal from the plant.
	14	Coast	Scouring or sedimentation at coastal area due to change of drifting sands and waves.	No	The river is not large and the coast is located far from the site.
	15	Fauna & Flora	Reduction of breeding and extermination of endangered species.	Yes	Fish species are generally protected in Lithuania.
	16	Climate	Climate change arising by implementation of large scale development of earthworks and structures.	No	No change due to small scale. Sewerage project is not a type to give an impact to climate.
	17	Landscape	Change in landscape due to earthworks and new structures.	Not sure	It is necessary to consider the harmony with the present landscape and preserve the natural zone.
Pollution	18	Air pollution	Air pollution caused by exhaust gas and poisonous gas from vehicles and factories.	No	No burning facility. Construction period is short term.
	19	Water pollution	Water contamination caused by inflow of soil, chemical substances, oil, etc.	Yes	The effluent from factories is generally organic and very limited in toxic substances. But the effluent may cause water pollution if not treated well.
	20	Soil contamination	Soil contamination caused by runoff and diffusion of effluent, poisonous substances, etc.	Yes	Waste sludge disposal may contaminate the soil.
	21	Noise/Vibration	Noise and vibration caused by running vehicles, pumping operation, etc.	No	No facilities with noise or vibration. The equipment is small in scale. The site is located in a rural area.
	22	Ground Subsidence	Ground surface subsidence caused by change of foundation condition and lowering of groundwater level.	No	No pumping of groundwater. Foudations are not deep except for a small potable water system for the plant.
	23	Odor	Occurrence of exhaust gas and odor.	Yes	Depending on the site location and the wind direction from the treatment plant and waste disposal sites.
Necessity of EIA				Yes	Already confirmed by MEP.

Table 5.4 Scoping

		Item	Impact	Remarks
Social Environment	1	Relocation	C	No inhabitant at the plant site. Pipeline is in private land.
	2	Economic activity	D	State land and not used at present. No adverse impact.
	3	Traffic/Public facilities	D	No particular increase which hinder traffic. Only rural roads.
	4	Division of Communities	D	No structure planned to separate the local community.
	5	Archaeological/ Cultural Heritage	D	No such sites in or nearby the project site.
	6	Vested Right	C	No impact in quantity. But, water contamination may cause of water use problems. The existence of vested right is not known.
	7	Health and Hygiene	C	Depending on the disposal of wastes and contamination of groundwater from effluent disposal. Drinking water is taken from the groundwater.
	8	Waste Disposal	B	Sludge waste and effluent disposal cause adverse impact from odor, soil contamination, etc., if not properly treated.
	9	Disaster/Accident	D	No such danger is worth consideration from the viewpoint of the small scale structures and topographic condition.
Natural Environment	10	Topography & Geology	C	The site is flat land. However, care is needed to prevent an impact to the karst zone. Birzai is in the active karst area.
	11	Soil erosion	D	The rainfall intensity is low. No remarkable scale of earthworks.
	12	Ground water	B	Depending on the disposal of wastes and contamination of ground water due to the effluent. High infilitration in karst area.
	13	River & Lake	B	Probable impact due to effluent disposal from the plant.
	14	Coast	D	The river is not large and the coast is located far from the site.
	15	Fauna & Flora	C	Fish species are generally protected in Lithuania. There may be protected animals in the rivers.
	16	Climate	D	No change due to small scale. Sewerage project is not a type to impact climate.
	17	Landscape	C	It is necessary to consider harmony with the present landscape and to preserve the natural zone. However, the STP site is not a significant site from the landscape viewpoint.
Pollution	18	Air pollution	D	No burning facility. The location is in a rural area.
	19	Water pollution	B	The effluent from factories is generally organic and very limited in toxic substances. But the effluent may cause water pollution, if not treated well.
	20	Soil contamination	C	Waste sludge disposal may contaminate the soil. The impact may depend on the treatment of sludge.
	21	Noise/Vibration	D	No facilities with noise or vibration. The equipment is small in scale. The site is located in a rural area.
	22	Ground Subsidence	D	No pumping of the ground water. Foudations are not deep.
	23	Odor	B	Depending on the site location and the wind direction from the treatment plant and waste disposal sites. The impact due to the treatment method of sludge should be considered.

Score: A-Significant impact anticipated.
B-Slight impact anticipated.
C-Unknown (subject to further verification)
D-Almost no impact anticipated and not subject for IEE and EIA.

Table 5.5 Overall Evaluation

Item		Impact	Necessary Survey	Remarks
1	Relocation	C	Existing houses and other structures at the proposed site. Land ownership of the proposed project site.	Necessity and difficulties of relocation as well as the land acquisition.
6	Vested Right	C	Vested right, especially for water use.	Water contamination may impact the present use of water.
7	Health and Hygiene	C	Location of treated effluent release. Possibility of contamination of groundwater. Location and method of waste sludge disposal.	Health problems may happen from contamination of groundwater due to effluent or waste disposal. Drinking water is taken from the groundwater.
8	Waste Disposal	B	Location, volume, contents/quality and method of waste sludge disposal.	Location as well as method of disposal is important.
10	Topography & Geology	C	Data collection on topography and geology of the project site. Field survey , if required. Special attention to karst zone.	Significant conditions of topography and geology may cause an adverse impact by the project.
12	Groundwater	C	Present conditions of groundwater, especially water quality. Geological condition in the project area. Influence by Karst form.	The influence of contaminated surface water to the groundwater is studied in consideration of Karst activity.
13	River & Lake	B	Present conditions of river & lake including the surrounding area. Water quality and runoff to a river & lake which may receive the effluent.	Alternative locations, if any, of effluent discharge are to be included.
15	Fauna & Flora	C	Fauna & flora in and around the project site. Endangered, significnat, protected species.	Fish species are generally protected in Lithuania. There may be protected animals in rivers.
17	Landscape	C	Landscape in and around the project area. Natural reserve or park.	It is necessary to consider harmony with the present landscape and natural area.
19	Water pollution	B	Present water quality and runoff to a river and lake which may receive the effluent.	The results of a water quality survey are an important factor as well as the other environmental components.
20	Soil contamination	C	Proposed location and method of waste sludge disposal. Present treatment of sludge.	Treatment method of sludge is significant to the level of impact.
23	Odor	B	Collection of weather condition including wind. Odor condition of the existing STP. Interview inhabitants near the STP.	Impact on odor depends on the site location , the wind direction from the treatment plant and waste disposal site. The impact due to the treatment method for sludge has to be considered.

Score: A-Significant impact anticipated.
B-Slight impact anticipated.
C-Unknown (subject to further verification)
D-Almost no impact anticipated.

Table 5.6 Brief Results of EIA for the Selected Components

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.

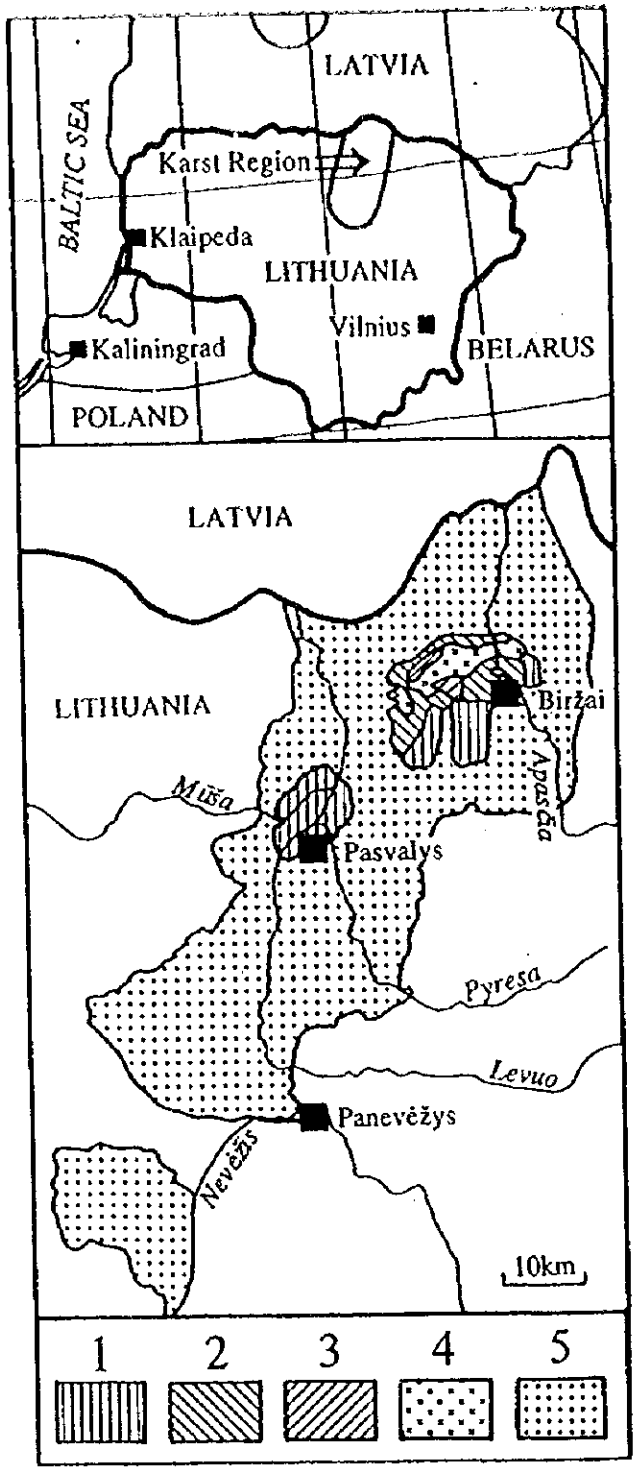
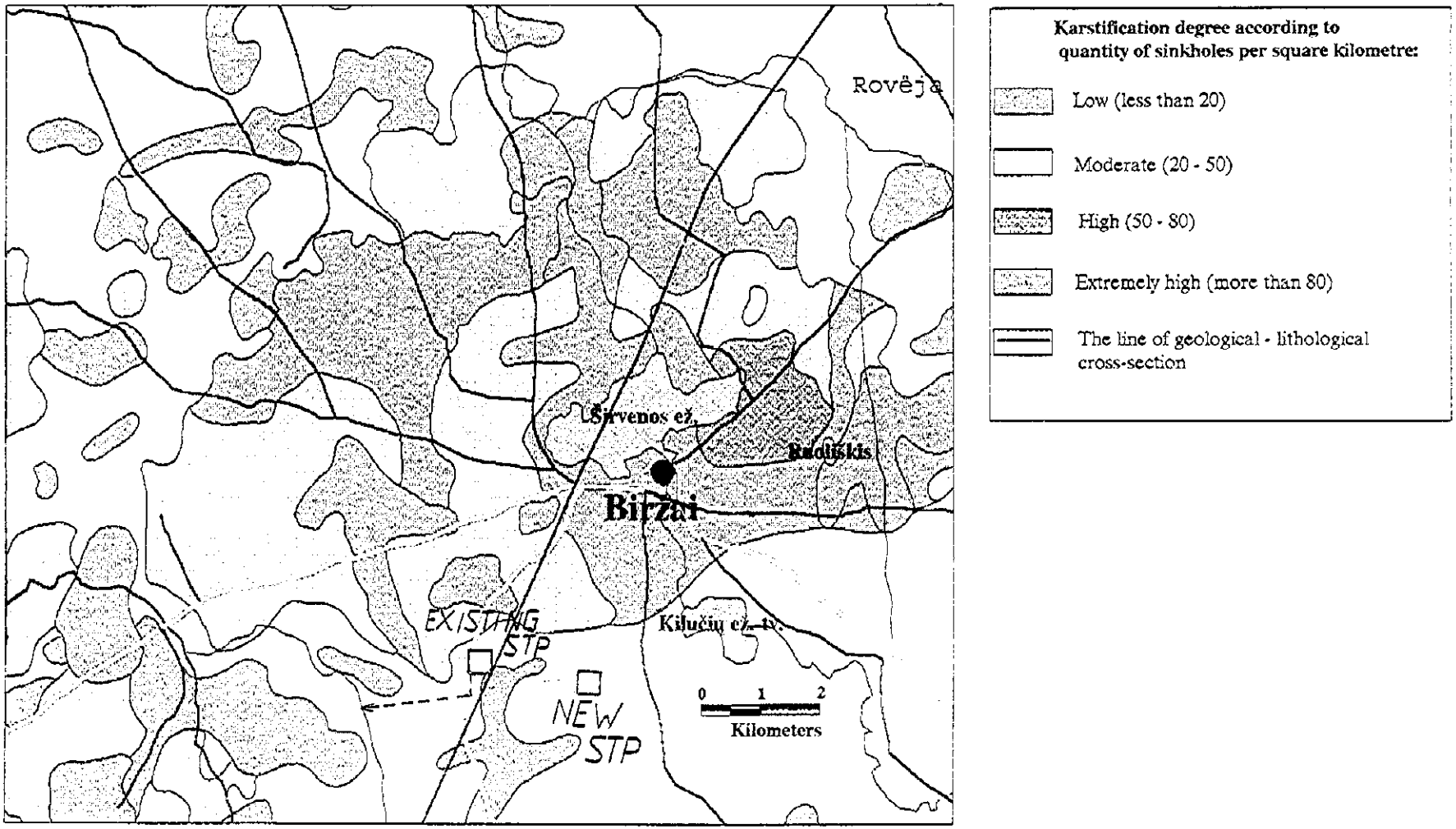


Figure 1. The location of the gypsum karst area in northern Lithuania and the agricultural protection zonation. 1. Land Group 1, less than 20 sinkholes/100ha; 2. Land Group 2, 20-50 sinkholes/100ha; 3. Land Group 3, 50-80 sinkholes/100ha; 4. Land Group 4, more than 80 sinkholes/100ha; 5. Karst protection zone; (100ha equals 1 sq km).

Data Source : Geological Survey (MOE)

Figure 5.1 General Location of the Gypsum Karst Area in North Lithuania



Data Source : Geological Survey (MOE)

Figure 5.2 **Location Map of Karstification Level of Birzai**

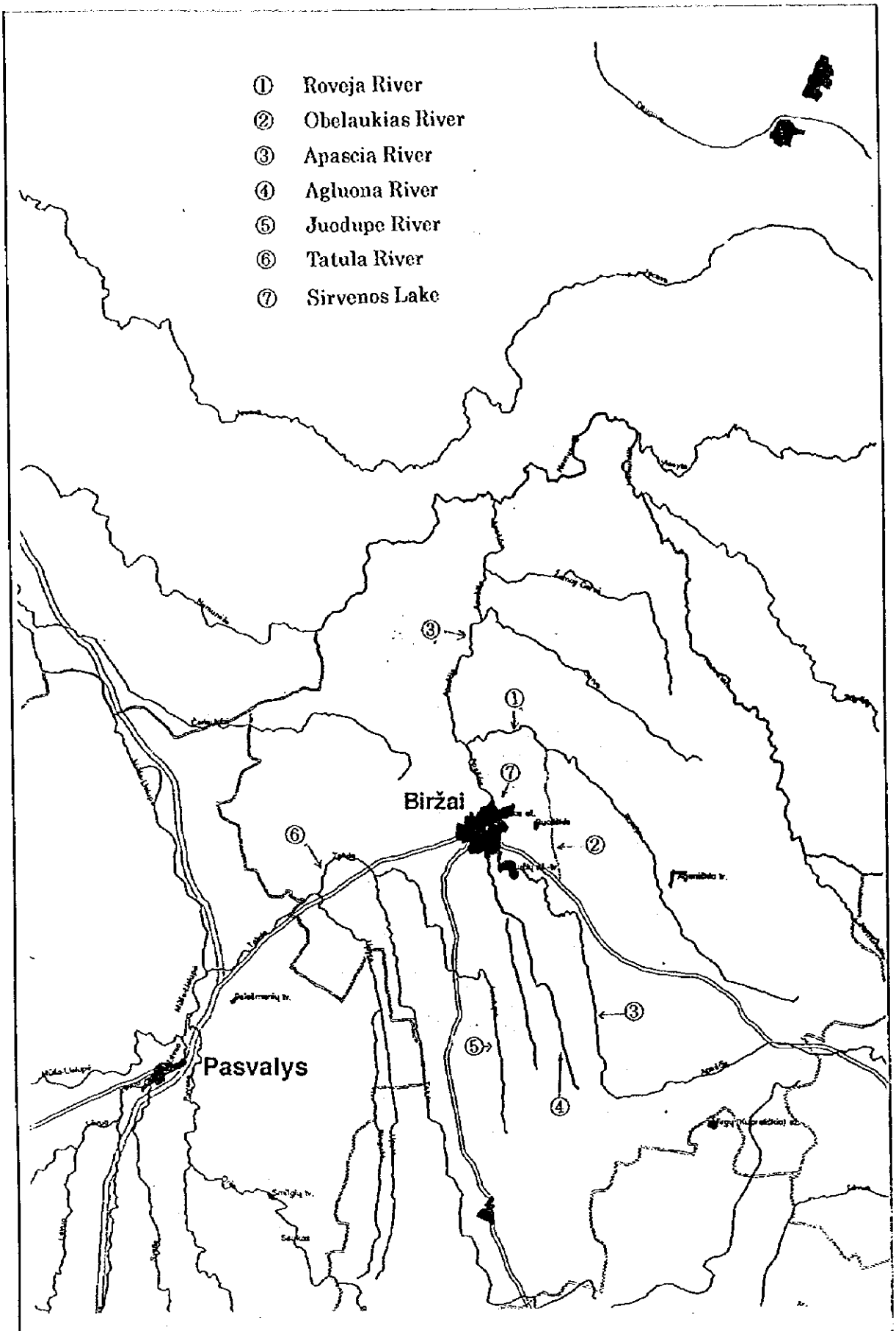


Figure 5.3 River System and Lakes in and around Birzai

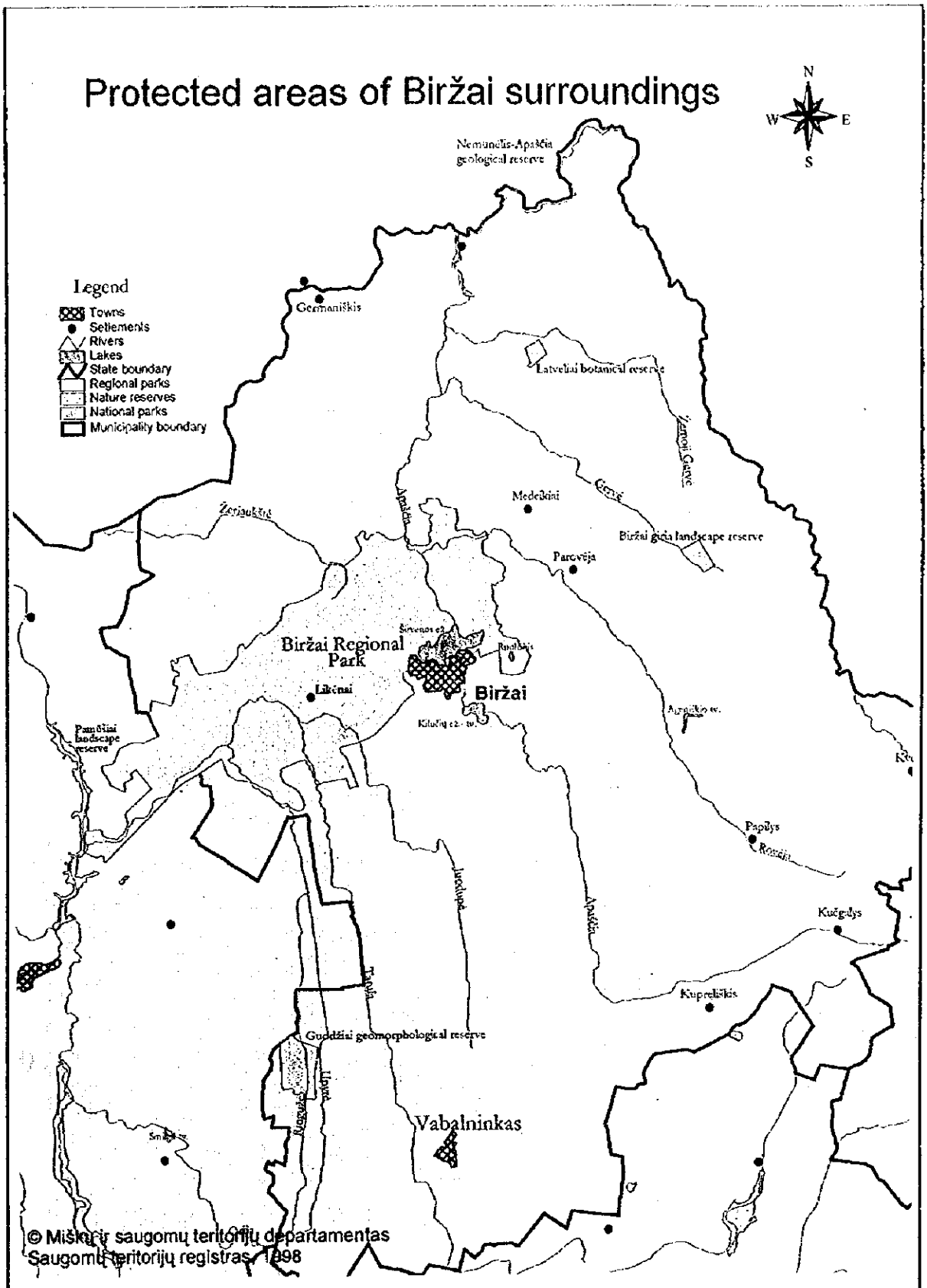


Figure 5.4 Protected Areas in Birzai

CHAPTER 6

CONCLUSIONS AND RECOMMNDATIONS

6 CONCLUSION AND RECOMMNDATIONS

6.1 CONCLUSION

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:

<u>Option 1</u>

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

<u>Option 2</u>

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.

6.2 RECOMMENDATIONS

6.2.1 Recommendations for Implementation

6.2.1.1 Recommendations for Construction of Project Facilities

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.

  Before 2010, the proposed treatment plant will be operated to less than the full capacity; effluent is therefore expected to be better than the design figures as experienced in many cases of treatment plant operation.

- **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

6.2.1.2 Recommendations for Industrial Wastewater Control

At present, there are no requirements for BOD levels in industrial wastewaters discharged from the factories into the sewerage system. Only the ratio of BOD to COD is specified at 2.5 as shown in Table 3.4 in Chapter 3.

In Birzai, only some factories (one dairy and two small breweries) have plans to construct their own treatment plants to reduce the organic substances in the wastewater before it is discharged to the sewerage system.

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.

Optimum pre-treatment system for the industrial wastewater should be dependent on the type of industry and characteristics of wastewater. The recommended concept for pre-treatment systems is however presented as follows:

Sedimentation

Sedimentation is useful for reducing suspended solid in wastewater. Organic matters contained in the solids will also be removed. Sedimentation is a very effective and economical measure when the wastewater contains high level of suspended solids. When the wastewater contains small amount of solids, most of organic substances are in liquid form. In such case, sedimentation will not be so effective.

Biological Treatment

Biological treatment must be applied when the wastewater contains high level of organic substances after sedimentation. There are several types of biological treatment options for strong organic wastewater as follows:

Anaerobic pond: Anaerobic pond is used for very strong organic wastewater (BOD of thousands mg/l) to reduce its BOD to less than 1,000 mg/l.

Aerated lagoon: Aerated lagoon consists of only shallow basins and surface aerators. This method is broadly applied for wastewater discharged from food industries because of the advantage that little amount of excess sludge is produced from the process. Ease of operation is also one of the advantages of this process. Disadvantage of this process is that it needs wide area due to a large volume of basin.

Oxidation ditch: Oxidation ditch is an effective treatment process for both industrial wastewater and domestic sewage of medium organic contents. As influent must be pre-treated to reduce BOD to around 500 mg/l, this process is not applied to high BOD wastewater without some pre-treatment.

Flow regulation

When a large amount of high BOD wastewater is discharged in short time, there may be a serious impact on the sewage treatment. When such an impact is anticipated, a balancing tank must be provided at a factory for flow regulation. The balancing tank can be a small tank with a retention time of a few hours with some outlet mechanism such as an orifice or an adjustable weir.

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.

6.2.1.3 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;

6.2.2 Recommendations for Future Development

6.2.2.1 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. Comparison of capacity of transmission and treatment facility is as follows:

Facility	Birzai
Transmission pipeline	dia. 400 mm max. flow = 10,900 m^3/day
Treatment plant	5,000 m^3/day

Note: Maximum capacity of transmission pipeline is estimated assuming the maximum velocity at 1.0 m/sec.

As shown above, 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.

6.2.2.2 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.

6.2.2.3 Control of Industrial Wastewater

As discussed in Section 6.2.1.2, 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.

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

As shown in the water quality data in Volume III Supporting Report, BOD in the Tatula River is around 2 mg/l at the sampling point upstream of confluence of the Judupe River. This shows signs of contamination which are likely caused by discharge of domestic sewage from communities along the river. To meet the special effluent standards for the Tatula River (BOD, 3.0 mg/l), the proposed treatment plant for Birzai will be required to operate tertiary treatment.

This figure however seems to be too strict considering the present water quality in the Tatula River. Effective way to improve the water quality of the Tatula River is to reduce pollution loads discharged from the upstream communities. To achieve that, it will be necessary to construct, modify, or expand the sewage treatment facilities at local communities upstream. In case the wastewater currently discharged from such communities is treated to the normal standards (BOD, 15 mg/l), water quality in the river is expected to improve.

It is therefore 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.