## 4.2 Evaluation of Existing Sewer Network

The hydraulic simulation of sewer network was carried out to evaluate hydraulic performance of the existing sewer network having diameters of 400 mm or larger for a total length of approximately 10 km. Results of this simulation are summarized in Table 4.2.

**Table 4.2 Results of Hydraulic Simulation of Existing Sewer Network**

| Classification of Sewer System | | F/C ≦ 100% | F/C ≦ 150% | F/C ≦ 200% | F/C > 200% | Total |
|---|---|---|---|---|---|---|
| Combined System | | 19 | 12 | 10 | 58 | 100 |
| Separate System | Storm Sewer | 22 | 12 | 10 | 57 | 100 |
| | Sanitary Sewer | 100 | - | - | - | 100 |

Note: F/C = (Planned sewage flow) / (Hydraulic capacity of sewer pipe)

Through the above evaluation, it was revealed that only 20 % of the total length of the existing major sewer pipes have enough hydraulic capacity to drain the planned sewage flow of the proposed project when these pipes are utilized as the combined sewer system. The remaining 80 % of major sewer pipes do not have enough hydraulic capacity.

When these pipes are utilized for storm sewer under the separate sewer system, almost same situation will occur, while they have sufficient hydraulic capacity when they are utilized as sanitary sewer under the separate sewer system.

## 4.3 Residents' Awareness on Environmental Sanitation

A total of 120 households (100 households in the sewered area and 20 households in unserved area of the existing sewerage system) was interviewed regarding their awareness on environmental sanitation. Major outcome of this questionnaire survey are summarized below:

a. About 90 % of households in the sewerage service area are discharging their wastewater into the sewer network, while the rest are discharging into street gutters or other open channels.

b. About 20 % of households recognize the relationship between unsanitary conditions and water borne/related/vector diseases.

c. About half of households have experiences diarrhea, dysentery and skin diseases and consider that these are caused by the quality of supplied water. In addition, more than 80 % of households suffer from red water for a total of 60 days in a year.

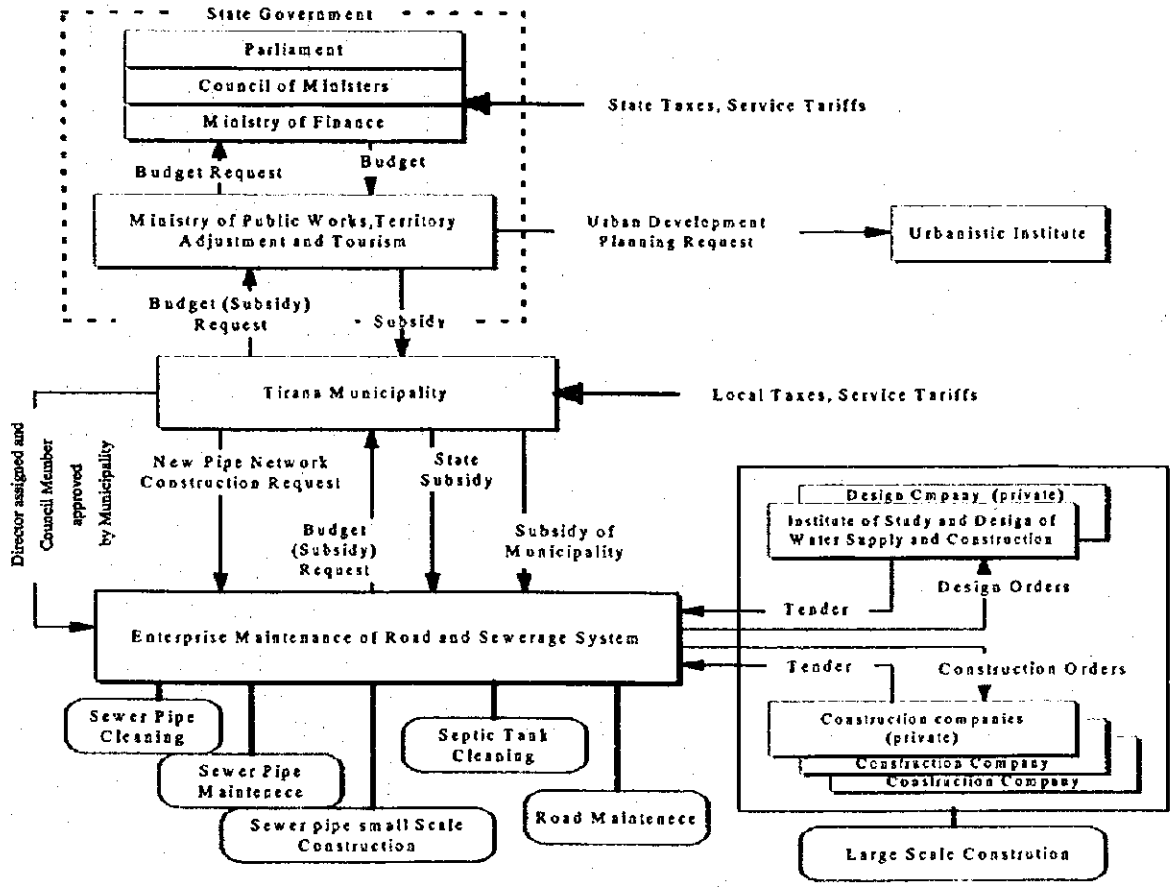
d. Average household income is about 15,000 Lek/month and better income level is at 25,000 Lek/month. About 10 % of these income are spent for electric charge.

e. Average amount of sewerage service fee as responded to willingness to pay is 50 to 100 Lek/month/household, while that of water supply is about double of this amount. Almost all households expect improvement of current water supply conditions.

# Chapter 5 Sewerage System Organization and Operation

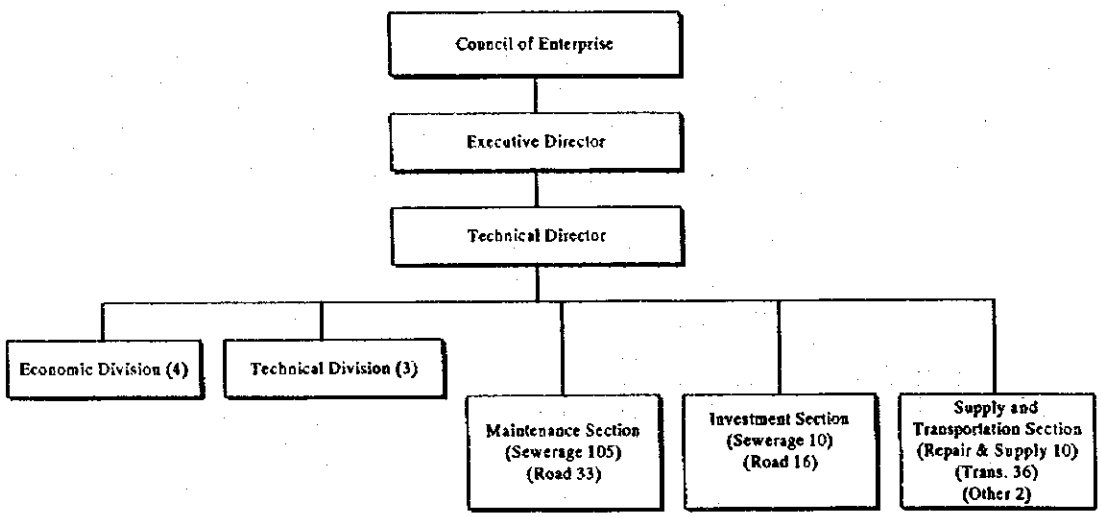
## 5.1 EMRS: Organization and Operations

The operational structure of the sewer enterprise for the city of Tirana can be broken down into the following two divisions: 1) planning and supervision, which are overseen by the Ministry of Public Works, Tourism and Territorial Adjustment (MOPWT) and Tirana Municipality; and 2) maintenance of facilities, which is overseen by the Enterprise Maintenance of Road and Sewerage System (EMRS), which in turn is supervised by the Municipality. These three institutions are directly responsible for the provision and upkeep of the sewer system of Tirana. However, in addition to these, there are the Institute of Study and Design of Water Supply and Construction (ISDWSC), which is responsible for sewer facility design, and the Urbanistic Institute, which is in charge of studying the urban area and coastline for development and designs.




EMRS, in addition to its responsibilities for maintenance of the sewers and roads of Tirana, is

also responsible for septic tank cleaning in those areas without sewer service. While EMRS handles the cleaning of sewer pipes itself, it outsources a relatively large portion of sewer construction projects to construction firms in the private sector, as they were all privatized with the switch to market economy in 1991. This outsourcing is done by the bidding process. The funds necessary for sewer maintenance, along with those for road maintenance, are completely provided by the national government and the Municipality. However, this funding is far shorter than what is actually necessary. EMRS has a staff of 254, as of January 1997, and the following figure is its organization.




EMRS is acting a budgetary organization and substantially all expenditures are subsidized by Tirana Municipality and MOPWT. Budgetary period begins on every 1 January and ends on every 31 December. Tirana City is consisted of 11 regions. From each region, requests come to EMRS for needs for its services. Based on its inspection and based on requests from the population, public and private organizations, EMRS drafts the plan of the investments for the following year. The plan is detailed for each investment to be done. Funds are pre-assigned for operational expenses and for investments. Use of the pre-allocated funds for another purpose is prohibited.

Tirana Municipality obtains the plan from EMRS. Based on EMRS's plan and on its own inspection and requests of the population, public and private organizations, Municipality drafts the plan of the investments to send and to be approved by MOPWT. The plan should be in accordance with the long-term city development planning. However, this is not the case with Tirana Municipality, because it does not have in place any long-term City development planing for Tirana. Austrian Environmental Experts Group is working in its preparation. In 1996 a

draft was presented, while the final version has not been delivered yet.

The draft-plan of the Municipality sent to MOPWT is in general the same as the one EMRS sent to the Municipality. Meanwhile, the Council of the Ministers approves the State budget and its distribution in the different branches of the economy of the entire country. MOPWT, the Directory of Coordination and Development, does the distribution of its funds to different directories.

**Table 5.1 Subsidy from the State government and Tirana Municipality**

Unit: Million Lek

| Year | Purpose of Subsidy | Plan | | | Actual |
|---|---|---|---|---|---|
| | | State Government | Tirana Municipality | Total | Total |
| 1992 | Investment | 1.00 | 0.00 | 1.00 | 5.23 |
| | Maintenance | 0.50 | 0.00 | 0.50 | 14.08 |
| | Total | 1.50 | 0.00 | 1.50 | 19.31 |
| 1993 | Investment | 7.00 | 0.00 | 7.00 | 20.87 |
| | Maintenance | 3.00 | 0.00 | 3.00 | 14.72 |
| | Total | 10.00 | 0.00 | 10.00 | 35.59 |
| 1994 | Investment | 12.00 | 0.00 | 12.00 | 19.79 |
| | Maintenance | 4.00 | 4.00 | 8.00 | 31.78 |
| | Total | 16.00 | 4.00 | 20.00 | 51.57 |
| 1995 | Investment | 14.00 | 4.60 | 18.60 | 18.33 |
| | Maintenance | 5.00 | 8.70 | 13.70 | 36.34 |
| | Total | 19.00 | 13.30 | 32.30 | 54.67 |
| 1996 | Investment | 40.00 | 5.20 | 45.20 | N/A |
| | Maintenance | 5.00 | 9.30 | 14.30 | 40.08 |
| | Total | 45.00 | 14.50 | 59.50 | --- |

EMRS has the Council which takes the main decisions which are of the competence of EMRS. The Council have monthly meetings for discussing the existing problems and issues. The agenda and minutes of the meetings are of concern and informed only to the Council. Only important topics are announced to the employees. In other cases, a memo is sent from the meeting to the Municipality and/or Ministry of Construction. The head of the departments and the responsible personnel of each region have weekly meetings. The main agenda of each meeting is about the work performed, what is remaining to be performed according to the plan of EMRS, and what will actually be done.

Requests from population, public and private organizations come to EMRS and cases are discussed in the meetings. When EMRS cannot support, requests are sent also to the Municipality and/or MOPWT. These inputs are used for making changes for emergency cases during the year and for planing of the coming year. MOPWT has its own controlling system which is planned according to the decision of the Council of EMRS. The Municipality does also checking and inspection at EMRS. It is the administrator of the funds sent to EMRS. State Control Commission has also the right to control and audit the enterprise. The feedback from these controlling plays part of the role of the feedback system of EMRS.

Auditing at EMRS is done in the following ways: 1) internally; 2) by the Municipality; 3) by the Auditing Branch of the Financial Directorate; and 4) by the State Controlling Commission. Some of this is announced beforehand, while other inspections are conducted unannounced. These are conducted on work performance, budget handling, and movement of funds and goods.

Accounting Law (Law No.7661) had been enforced by the Government of Albania on 19 January 1993. According to the Article 2 of the Law, this law is applied to all participating subjects in economy, legal and physical persons, registered in the Republic of Albania, either of profit-, or not-for-profit purposes, but which perform economic activities. Accounting Law is also applied to public institutions and entities, in center and in districts, which represent independent budgetary or of budgetary character units, and units created from them. Uniform accounting system defines accounting procedures, chart of accounts, form of financial reporting and accounting period.

Before the change of economic system in a free market economy, all of the legal persons were part of the public sector. For the purpose of economic planning, all of their accounting data is recorded and maintained by themselves, and centralized to and processed by each regional Center for Treatment of Accounting Information (the "Center"). After the change of economic system and in progress of privatization, such centralized accounting processing is not required to private sector legal person. However, even nowadays, EMRS shares its accountability with the Center in Tirana as in planned economy. EMRS's financial reporting is simple. It does not prepare any managerial accounting information, such as disaggregated by each department accounting, comparison against budget, or analysis with actual work performed.

Per EMRS's financial statements, 90 % of total assets is fixed assets, and accounting for fixed assets is very important. Per result of limited procedures as for the reliability of fixed assets

accounting, following irregular items found and the past financial statements seems not reliable.

Construction contracted out has not been recognized as assets of EMRS. Fixed assets, accumulated depreciation, and depreciation expense would understate by such amount. Subsidies received from governments are treated as revenue and consists taxable income. This means that donated capital might be distributed and capital is not kept as initial basis. Depreciation is very roughly performed, due to its complexity and depreciation is performed group basis.

## 5.2. Legal Systems

Until April 29, 1991, Albania was known as the Socialist People's Republic of Albania. On this date, "The Main Constitutional Dispositions" were enacted, and the nation began the transition to market economy. Along with those laws enacted by the Parliament, there are also Presidential decrees, Decisions by the Council of Ministers, and Minister-level Decisions. While this system has brought some progress in the making of a legal system, there are still laws which overlap, as well as gaps between others. Consequently, the nation is working towards reform of its legal system.

The Albanian legal system is a European continental one, and the legislative and administrative structure is as follows:

(1) Constitutional laws
(2) Laws adopted by Parliament
(3) Decrees of the President approved by Parliament
(4) Decisions, orders and instructions of the Council of Ministers
(5) Orders, regulations and instructions by Ministers
(6) Prefectural decisions and orders
(7) Decisions and orders set by councils at the district, municipal, and community level
(8) Decisions and orders set by municipal and community leaders

Concerning laws and regulations on sewerage system and related subjects, a series of legal acts regarding management and privatization have brought laws on sewer systems and water supply to where they are today: 1) laws on the ownership and management of EMRS ("On State Enterprise"; 1992); 2) laws on the operation of EMRS and the water supply ("On Regulatory

Frameworks for Water Supply, Sewer Systems and the Waste Water Treatment Sector"; 1996); and 3) laws on operation and privatization of EMRS and the water supply ("On Privatization of Water Supply, Sewer Systems and the Waste Water Sector";1996). In addition to these, the Environmental Protection Law was also enacted in 1993. While laws on water quality standards date from prior to 1991, these are currently under reexamination.

## 5.3 Condition of Privatization

The move to privatize nationally-owned enterprises began in 1991 with the shift to market economy. Since then, approximately 160 enterprises have been privatized. The three stages listed below provide a simple explanation of Albania's privatization process.

Stage 1: The privatization of nationally-owned business enterprises

Stage 2: The privatization of small- to mid-size construction firms

Stage 3: The privatization of large corporations through the 1995 introduction of the voucher system

In March 1996, the law was passed which gave the water supply and sewer enterprises the right to switch to the private sector. The water supply enterprise, which has since then instituted a tariff system, is in the midst of consultation with the World Bank on the prospects of privatization. That project is forecast to be finished this year. However, there are those within the water supply enterprise who have their doubts that full privatization (via the sale of assets) will be possible.

# Chapter 6 Results of Water Quality Examination

## 6.1 Sampling Program

A series of water quality examination was conducted as a part of the field work in the Study to grasp characteristics of sewage/wastewater being discharged from different pollution sources and to reflect upon the framework of future sewerage system as well as identification of urgent/priority project for improvement of urban environment and conservation of public water body.

Water sampling was carried out at different sampling locations covering the Tirana River, the Lana River and existing sewer lines to obtain water samples of domestic sewage, and at discharge points of industrial and agricultural wastewater. This sampling was conducted from September to October, 1996 as dry season and from January to February, 1997 as rainy season. The sampling in rainy season, however, did not encounter any rain.

Water sampling program in each season is shown in Table 6.1.

**Table 6.1 Water Sampling Program in Each Season**

| Mode of Sampling and Water Quality Analysis | Tirana River | Lana River | Domestic Sewage | Industrial Wastewater | Agricultural Wastewater |
|---|---|---|---|---|---|
| 1. Sampling Location | 1-Upstream<br>1-Downstream | 1-Upstream<br>1-Downstream | 4-Sewer Line | 4-Discharge Point | 2-Discharge Point |
| 2. Sampling Method<br>(1) Frequency | Once | Twice | Once | Once | Once |
| (2) Individual Sample | 4 hour interval<br>6:00, 10:00, 14.00, 18.00 and 22.00 | | | One time | |
| (3) Composite Sample | 1-composite sample by mixing of 5 individual samples for every sampling point | | | No composite sample | |
| 3. Water Quality Analysis<br>(1) BOD, COD, SS, pH, Temp., Transp., Coliform | 2-composite samples | 4-composite samples | 4-composite samples | 4-individual samples | 2-individual samples |
| (2) COD, SS, pH, Temp., Trans., Coliform | 10-individual samples (5 samples x 2 points) | 20-individual samples (5 samples x 2 points x 2 times) | 20-individual samples (5 samples x 4 points) | Not applicable | |

## 6.2 Examination Results

(1) River water

A simultaneous sampling at upstream and downstream of the Tirana River and the Lana River was carried out. The same manner of sampling was also applied to the Lana river and domestic sewage to wit relationship between pollution sources and receiving water body.

In the Tirana River, BOD of composite sample at upstream was only 2 mg/l, while that of downstream was about 20 to 23 m/l.

With regard to the Lana river, average BOD at upstream were 23 to 36 mg/l. In the downstream, they were 42 to 73 mg/l. In general, water quality in rainy season was approximately 50 % higher than that in dry season.

**Table 6.2 Water Quality in the Tirana River and the Lana River**

Unit: mg/l

| River | Season | Upstream | | Downstream | | STP*2 | |
|---|---|---|---|---|---|---|---|
| | | BOD | COD | BOD | COD | BOD | COD |
| Tirana River | Dry | 2 | 4 | 20 | 29 | - | - |
| | Rainy | 2 | 3 | 23 | 34 | 31 & 24<br>Ave. 28 | 42 & 35<br>Ave. 39 |
| Lana River | Dry | 1*1 | 3*1 | 34 & 49<br>Ave. 42 | 44 & 70<br>Ave. 57 | - | - |
| | Rainy | 1*1 | 3*1 | 62 & 83<br>Ave. 73 | 80 & 100<br>Ave. 90 | - | - |

Note: Data of upstream and downstream are referred to composite samples.
*1: The data of Lana River Upstream is from the point "Agricalture-1" in Figure 6.1.
*2: "STP" indicates proposed discharge point of treated effluent from the STP.

As a whole, it is obvious that the absence of sewage treatment plant has been causing serious water pollution at downstream of the Tirana River and the Lana River.

The agricultural wastewater sampled at the uppermost stream of the Lana river was only 2 mg/l of BOD. This result could be considered as the natural pollution load of the Lana river and equivalent to the upstream of the Tirana River.

(2) Domestic sewage

Water sampling was carried out at three different localities, namely new apartment building area, old apartment building area and individual housing area. Sampling at new apartment building area was carried out for two times in each season.

Table 6.3 BOD and COD of Domestic Sewage (Composite Sample)

Unit: mg/l

| Sampling Location | BOD | | COD | |
|---|---|---|---|---|
| | Dry Season | Rainy Season | Dry Season | Rainy Season |
| New Apt. Bldg. | 133 & 232<br>Ave. 183 | 167 & 350<br>Ave. 259 | 88 & 142<br>Ave. 115 | 105 & 170<br>Ave. 138 |
| Old Apt. Bldg. | 182 | 236 | 240 | 362 |
| Individual Housing | 267 | 440 | 214 | 250 |
| Average | 211 | 190 | 312 | 250 |

BOD analysis results fluctuate by type of housing and by season. However, reasons on these fluctuations are not clearly identified even through questionnaire survey to residents' awareness in respective area.

(3) Industrial wastewater

The largest factory at present is a food processing industrial complex located at southwest part of Tirana City and discharging its wastewater into brook which is finally flowing into the Lana River. The rest of factories are mostly small scale, such as meet processing factory to produce sausage and ham being located at the central part of Tirana City.

Table 6.4 Analysis Results of Industrial Wastewater

| Site Number | Type of Factory | pH (-) | Turb. (mg/l) | SS (mg/l) | BOD (mg/l) | COD (mg/l) |
|---|---|---|---|---|---|---|
| 1 | Food Processing Complex | 5.80 | 119 | 133 | 485 | 959 |
| | | 6.80 | 79 | 85 | 327 | 613 |
| 2 | Liquor Manufacturing | 6.85 | 34 | 58 | 288 | 477 |
| | | 7.02 | 35 | 40 | 154 | 273 |
| 3 | Industrial Complex (Milk & Soap) | 7.18 | 50 | 69 | 110 | 237 |
| | | 7.40 | 130 | 132 | 282 | 487 |
| 4 | Meat Processing | 6.68 | 163 | 234 | 304 | 615 |
| | | 7.01 | 200 | 205 | 533 | 1,277 |

Note: Upper - Dry season, Lower - Rainy season

Water sample from Industrial Complex (Site No.3) was obtained at manhole of sewer lines wherein certain amount of domestic sewage seems to be mixed due to recent housing developments.

In view of discharged pollution load, the Food Processing Complex (Site No.1) and Meat Processing Factory (Site No.4) are considered major pollution sources.

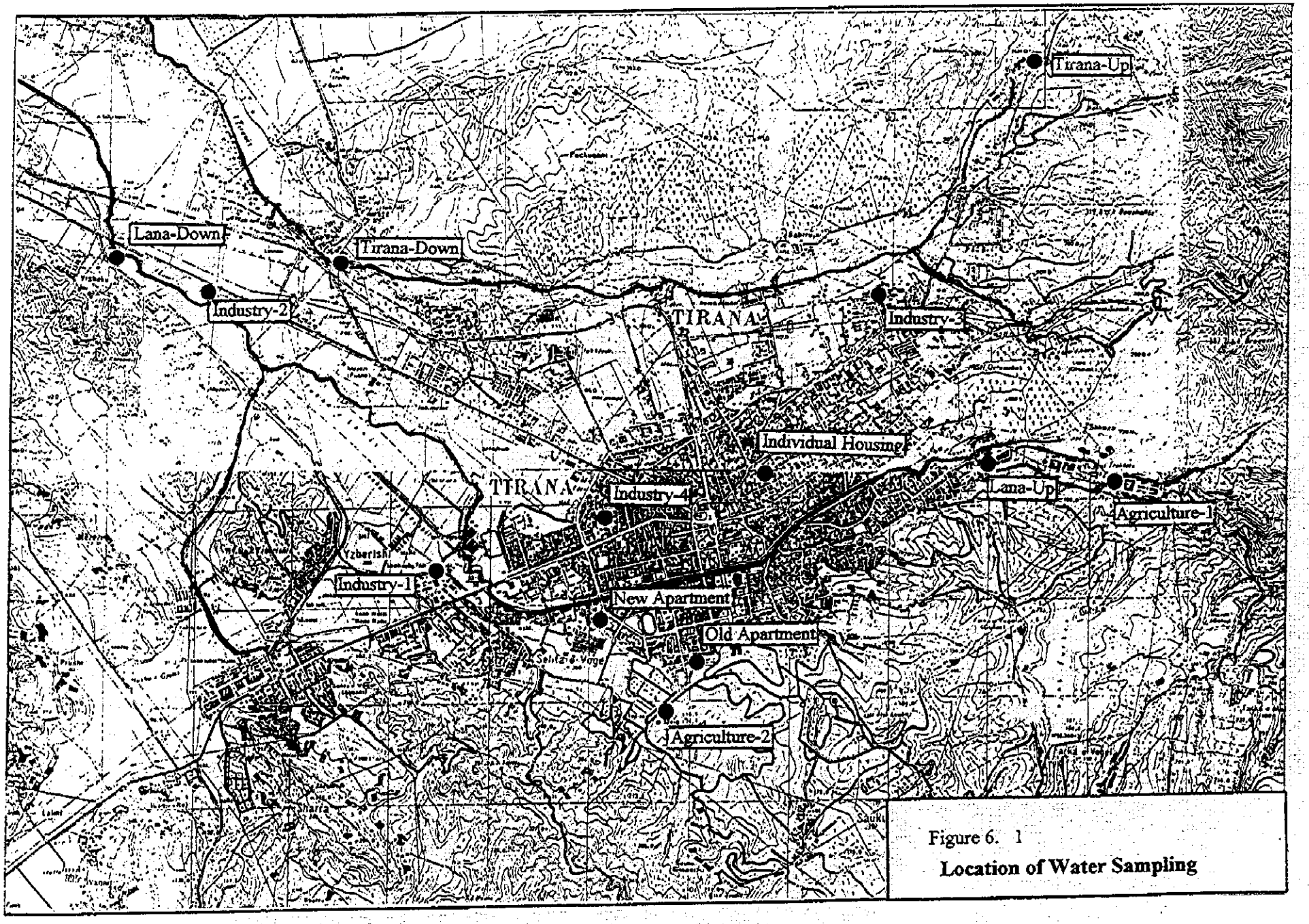



Figure 6. 1

**Location of Water Sampling**

# Chapter 7 Approach to Sewerage System Planning

## 7.1 Principal Approach to Sewerage System Planning

(1) Principal objectives of implementing sewerage project

Prior to establish the planning fundamentals for the sewerage project, the principal objectives to be achieved by the proposed project are redefined as follows:

1) Improvement of public hygiene and living environment in Metropolitan Tirana through development of sewerage system

2) Improvement of water quality in the Tirana River and the Lana River aiming at the wastewater discharge standard level set by the national regulations by the following countermeasures:
   - Minimize direct discharge of raw sewage into the rivers, and
   - Treat collected sewage at the sewage treatment plant to meet the requirements of national regulation (BOD 25 mg/l)

(2) Selection basis for sewerage planning area

Criteria to determine the target area of sewerage planning are established taking into account the above mentioned principal objectives and the present service area of the existing sewerage system, as follows:

1) Expansion area shall adjoin to the service area of the existing sewerage system
2) Expansion area shall, in principle, have topographic feature to drain collected sewage into the existing sewer lines by gravity flow
3) Expansion area shall have reasonable population density to attain economic efficiency
4) Expansion area shall be of legally developed or legally planned area, such as Type-1 or Type-5 specified in the Land Use Plan.

## 7.2 Fundamentals for Sewerage Planning

### 7.2.1 Planned Sewerage Service Area

The expansion area of sewerage system with an area of 565 ha is selected from a total of 12 zones based on the above criteria and indicated in Figure 7.1.

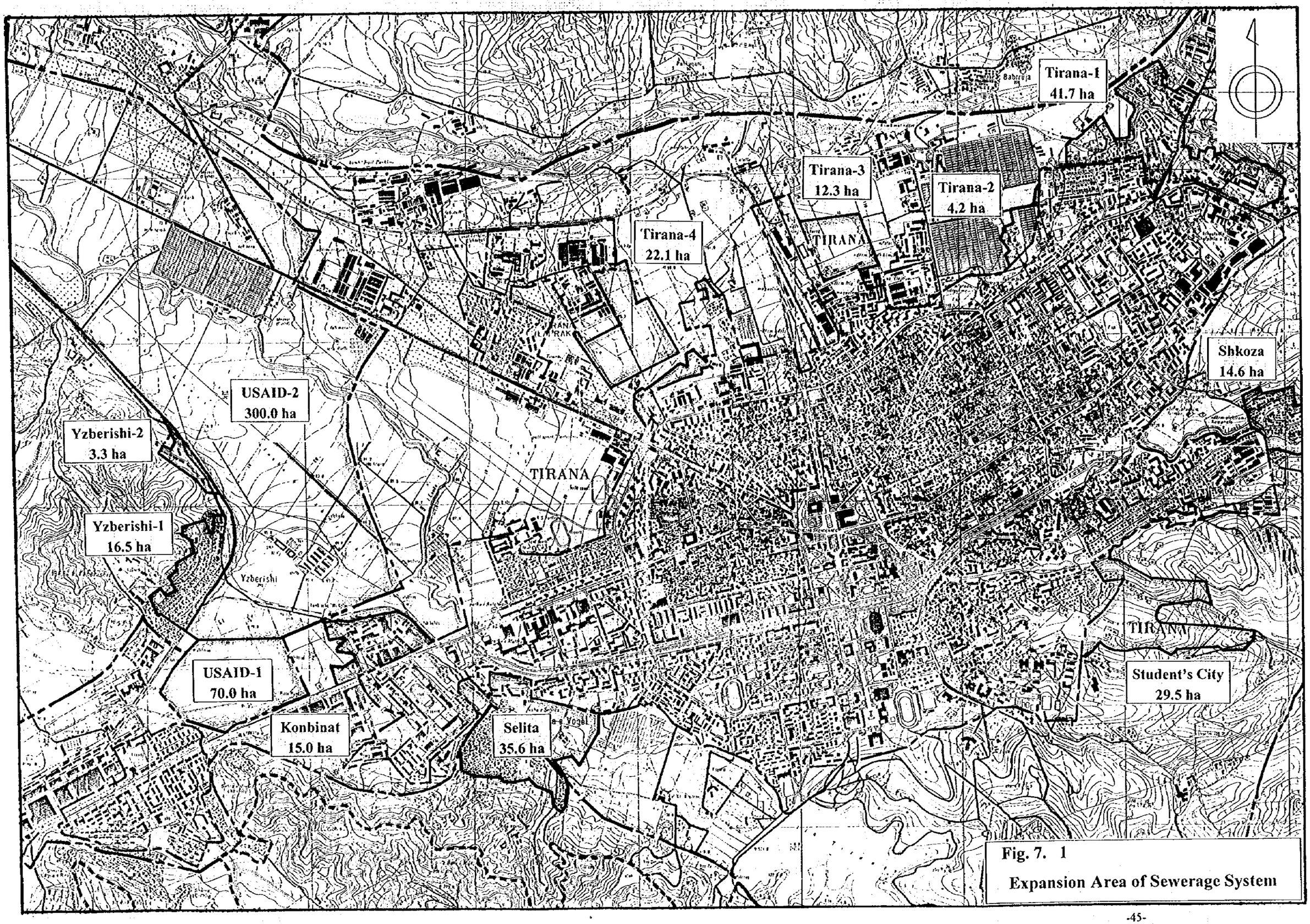



**Fig. 7. 1**

**Expansion Area of Sewerage System**

The overall target area for sewerage planing is 1,810 ha consisting of:

- 1,245 ha of the service area of the existing sewerage system, and
- 565 ha for expansion area.

### 7.2.2 Population to be Served by Sewerage System

Served population of the sewerage system is estimated based on the future population established by type of land use as described in Chapter 3. Served population and service area of the sewerage system is shown in Table 7.1.

**Table 7.1 Planned Sewerage Service Area and Service Population**

| Zone | | | Area (ha) | Population (person) | | |
|---|---|---|---|---|---|---|
| | | | | 1996*2 | 2001*3 | 2010*3 |
| Existing Service Area*1 | Tirana River | | 213.6 | 47,914 | 51,000 | 56,600 |
| | Center | | 183.2 | 46,497 | 49,500 | 54,900 |
| | Lana-North | | 396.4 | 117,262 | 124,900 | 138,600 |
| | Lana-South | | 380.6 | 108,070 | 115,100 | 127,700 |
| | Kombinat | | 71.0 | 17,640 | 18,800 | 20,800 |
| | Total | | 1,244.8 | 337,383 | 359,300 | 398,600 |
| Expansion Service Area*2 | Lana-South | Shkoza | 14.6 | 5,706 | 5,900 | 6,600 |
| | | Selita | 35.6 | 7,871 | 8,100 | 8,600 |
| | | Kombinat | 15.0 | - | - | - |
| | | Student's City | 29.5 | 5,424 | 5,400 | 5,400 |
| | | Sub-Total | 94.7 | 19,001 | 19,400 | 20,600 |
| | USAID | USAID-1 | 70.0 | 0 | 5,000 | 14,000 |
| | | USAID-2 | 300.0 | 1,674 | 22,500 | 60,000 |
| | | Yzberishi-1 | 16.5 | 3,840 | 4,000 | 4,400 |
| | | Yzberishi-2 | 3.3 | 758 | 800 | 900 |
| | | Sub-Total | 389.8 | 6,272 | 32,300 | 79,300 |
| | Tirana | Tirana-1 | 41.7 | 16,263 | 16,900 | 18,700 |
| | | Tirana-2 | 4.2 | 1,049 | 1,000 | 1,100 |
| | | Tirana-3 | 12.3 | 2,460 | 2,500 | 2,500 |
| | | Tirana-4 | 22.1 | 2,100 | 2,900 | 4,400 |
| | | Sub-Total | 80.3 | 21,872 | 23,300 | 26,700 |
| | Total | | 564.8 | 47,145.0 | 75,000 | 126,600 |
| Grand Total | | | 1,809.6 | 384,528 | 434,300 | 525,200 |

Note: *1 - Existing service area is measured on the maps by the Study Team.
*2 - Present population and expansion service area are referred to "Housing Typology of Existing Land Use" (MOPWT); details are referred to Tables 7.2.2 and 7.2.3 in Appendix 7.2.1.
*3 - Future population is projected by the Study Team.

### 7.2.3 Planned Sewage Flow

(1) Unit per capita sewage quantity

Unit per capita sewage quantity is calculated as follows:

$$\text{Unit Quantity} = q - q_{\text{-Leakage}} + q_{\text{-Infiltration}}$$

where, $q$ : Unit water consumption (l/cap/day)

$q_{\text{-leakage}}$ : Sewage leakage from sewer pipe

$q_{\text{-Infiltration}}$ : Groundwater infiltration to sewer pipe

1) Unit per capita water consumption

a. Daily average

$q_{\text{Daily Ave.}} = 170 / ( 1 - 0.3 ) = 243$ l/cap day

where, 170 l/cap/day : Unit domestic water consumption

0.3 : Non-domestic use ratio

c. Hourly maximum

$q_{\text{Hourly Max.}} = 243 \times 2.0 = 486$ l/capita/day

where, 243 l/capita/day: Daily average per capita unit water consumption

Peak factor is adopted as 2.0 considering that the hourly consumption rate becomes higher when the additional water sources are not secured to meet with the increased water demand.

2) Leakage of sewage from sewer network

The present leakage rate of 40 % is assumed to be improved to 35 %.

$q_{\text{-Leakage}} = 243 \times 0.35 = 85$ l/capita/day

where, 243 l/capita/day: Daily average unit water consumption

3) Groundwater infiltration to sewer pipe

Groundwater infiltration to sewer pipe is assumed at 15 % of the daily average sewage flow.

$q_{\text{-Infiltration}} = 243 \times 0.15 = 36$ l/capita/day

where, 243 l/capita/day: Daily average unit water consumption

4) Planned unit sewage quantity

a. Daily average

$q_{Daily\ Ave.}$ = 243 - 85 + 36 = 194 l/capita/day say, 200 l/capita/day

b. Hourly maximum

$q_{Hourly\ Max.}$ = 486 - 85 + 36 = 437 l/capita/day say, 440 l/capita/day

5) Daily maximum

As discussed in Chapter 3, the present water supply conditions will be remarkably improved upon completion of Bovilla water treatment plant by the year 1999 and the water supply system will be able to cope with the increase of water demand for the mean time. However, further increase of water demand by the target year of 2010 will not be managed by the existing water sources. Future water sources are not identified yet.

In due consideration of the above mentioned situation of water supply through the future, seasonal fluctuation of sewage volume to be discharged in the sewerage planning area will not be foreseen owing to the restrictive conditions of water supply capacity, even if water demand varies seasonably. Therefore, the planned daily maximum per capita unit water consumption $q_{Daily\ Max}$ is not considered in this Study.

(2) Planned sewage flow

1) Daily average sewage flow

Table 7.2 shows planned sewage flow at treatment plant calculated on the daily average basis.

**Table 7.2 Planned Sewage Flow for STP**

| Zone | Population (person) | | | Planned Sewage Flow ($m^3$/day) |
|---|---|---|---|---|
| | Existing | Expansion | Total | |
| Tirana River | 56,600 | 26,700 | 83,300 | 16,660 |
| Center | 54,900 | | 54,900 | 10,980 |
| Lana-North | 138,600 | | 138,600 | 27,720 |
| Lana-South | 127,700 | 20,600 | 148,300 | 29,660 |
| Kombinat | 20,800 | | 20,800 | 4,160 |
| USAID | | 79,300 | 79,300 | 15,860 |
| Total | 398,600 | 126,600 | 525,200 | 105,040 |

Note: Planned sewage flow as daily average

2) Hourly maximum sewage flow

As a base figure for sewer network design, the planned hourly maximum sewage flow is estimated as shown in Table 7.3. The figures shown in "3Q" mean the intercepted sewage flow at three times of dry weather flow under the rainy conditions and are utilized to design interceptor and trunk main.

**Table 7.3 Planned Sewage Flow for Sewer Pipe**

| Existing Area | | Expansion Area | | Population | Planned Sewage Flow | | |
|---|---|---|---|---|---|---|---|
| Name | Population | Name | Population | Total | ($m^3$/day) | ($m^3$/sec) | 3Q($m^3$/sec) |
| Tirana River | 56,600 | Tirana-1 | 18,700 | 83,300 | 36,652 | 0.424 | 1.273 |
| | | Tirana-2 | 1,100 | | | | |
| | | Tirana-3 | 2,500 | | | | |
| | | Tirana-4 | 4,400 | | | | |
| | | Sub Total | 26,700 | | | | |
| Center | 54,900 | - | - | 54,900 | 24,156 | 0.280 | 0.839 |
| Lana-North | 138,600 | - | - | 138,600 | 60,984 | 0.706 | 2.118 |
| Lana-South | 127,700 | Shkoza | 6,600 | 148,300 | 65,252 | 0.755 | 2.266 |
| | | Student's City | 5,400 | | | | |
| | | Selita | 8,600 | | | | |
| | | Kombinat | - | | | | |
| | | Sub Total | 20,600 | | | | |
| Kombinat | 20,800 | - | - | 20,800 | 9,152 | 0.106 | 0.318 |
| USAID | - | USAID-1 | 14,000 | 79,300 | 34,892 | 0.404 | *0.404* |
| | | USAID-2 | 60,000 | | | | |
| | | Yzberishi-1 | 4,400 | | | | |
| | | Yzberishi-2 | 900 | | | | |
| | | Sub Total | 79,300 | | | | |
| Total | 398,600 | | 126,600 | 525,200 | 231,088 | 2.675 | 7.216 |

Note : Planned sewage flow as hourly maximum in 2010

(3) Planned stormwater flow

1) Run-off formula

The rational run-off formula is widely used for computing storm water quantity. Whereas some of the factors are shown below;

$Q = C\ I\ A$

where, Q : Storm water quantity; $m^3$/sec

C : Run-off coefficient

I : Rain fall intensity; mm/h

A : Catchment area; ha

2) Rainfall intensity formula

The Talbot's formula is broadly adopted in all over the world as an effective and simple method of calculation of rainfall quantity. The Talbot's formula is given below.

a. Major sewer lines (4 year return period)

$$I_4 \text{ (mm/hr)} = \frac{2,750}{t + 17}$$

b. Lateral sewers (2.5 year return period)

$$I_4 \text{ (mm/hr)} = \frac{2,520}{t + 17}$$

3) Run-off coefficient

When the existing and future land use as well as roads and housing conditions are taken into account, 0.5 of the run-off coefficient shall be uniformly applied for the whole of the sewerage planning area in this Study. However, larger figure of run-off coefficient (0.6 to 0.7) may be considered in the future when infiltration area (open space) is decreased corresponding to the progress of urbanization.

4) Concentration time

Concentration time is defined as a sum of the inlet time required for rainwater to reach storm sewer inlets and the time of flow for collected storm water to reach sewage treatment plant, as shown in the following formula:

$$t = t_1 + t_2$$

where, t: Concentration time

$t_1$: Inlet time

$t_2$: Time of flow (=L/V; V m/sec-Assumed average velocity)

Based on the Albanian method of hydrology, the following factors are adopted in calculation of the concentration time:

- Inlet time; 5 minutes, and
- Time of flow using assumed average velocity of 1.5 m/sec.

### 7.2.4 Planned Sewage Quality

(1) Domestic sewage

Per capita unit pollution load (BOD) is set forth at 45 g/capita/day. When the reduction of pollution load by leakage of sewage from sewer pipes is taken into account, per capita pollution load will be:

45 g/capita/day x (1 - 0.35) = 29.25 g/capita/day

Discharged sewage volume: 170 l/capita/day x (1 - 0.35 + 0.15) = 136 l/capita/day

where, Leakage from water distribution pipe and sewer pipe: 35 %

Groundwater infiltration to sewer pipe: 15 %

Resultant from the above calculation, domestic sewage quality will be:

BOD = (29.25 g-BOD/capita/day) / (136 l/capita/day) = 215 mg/l

(2) Commercial and institutional sewage

BOD concentration of commercial and institutional sewage is assumed to be 2/3 of the domestic sewage:

BOD = 215 mg/l x 2/3 = 143 mg/l

3) Industrial wastewater

Most of operating factories in Tirana City are food processing. Based on the water quality examination results, industrial wastewater quality is estimated at 300 mg/l of BOD.

4) Mixed sewage

BOD = 215 x 0.70 + 143 x 0.23 + 300 x 0.07 = 204 mg/l say, 200 mg/l

SS of the mixed sewage is also assumed at 200 mg/l referring to the water quality examination results.

## 7.3 Sewage Collection System

### 7.3.1 Design Criteria of Sewers

(1) Intercepting capacity

3 times of dry weather flow

(2) Hydraulic calculation

The Manning's formula is adopted with roughness coefficient at n=0.013 (concrete pipe).

(3) Flow velocity

| | |
|---|---|
| Combined systemand storm sewer of separate system: | 0.8 to 3.0 m/sec. |
| Sanitary sewer of separate system: | 0.6 to 3.0 m/sec. |

(4) Sewer capacity

No allowance is considered for combined system and storm sewer of separate system, while 100 % for 600 mm or smaller size and 75 % for larger than 600 mm of allowance is considered for sanitary sewer of separate system.

### 7.3.2 Improvement of Existing Sewer Network

Hydraulic simulation of the existing sewer network revealed that about 80 % of sewer pipes had insufficient capacity. The improvement alternatives were then studied for a total length of about 66 km sewer pipes with diameters of 400 mm or larger in the Lana North and Lana South areas and major sewer pipes having diameters of less than 300 mm. Rough cost estimate for their improvement was prepared to cover whole sewer pipes.

(1) Alternative plans for improvement of sewage collection system

The following four alternatives were selected and studied:

a. Improvement of the sewer pipes as the combined system
   - a-1 Replacement with new pipe having required flow capacity
   - a-2 Supplemental installation to compensate insufficiency of existing pipes

b. Introduction of separate system
   - b-1 Utilization of the existing combined sewers as sanitary sewer and construction of new storm sewer.

b-2 Utilization of the existing combined sewers as storm sewer together with construction of supplemental storm sewer to compensate lack of flow capacity, and construct new sanitary sewer.

Results of comparative study on these alternatives are summarized in Table 7.4. Taking into account the present conditions of the existing sewer network, the following comments were stemmed from the evaluation of alternatives:

1) About 80 % of the major sewer pipes have insufficient hydraulic capacity and require thorough renovation.

2) The existing sewer pipes will reach to the end of their service life and increase of sewage leakage from these pipes will be unavoidable state.

3) The cost for improvement varies for about 20 % between the highest and the lowest.

Resultant from the above, it is recommended that the existing sewer network shall be converted and improved to be the separate system through utilization of existing sewers as the storm sewer and construction of new sanitary sewer (Alternative "b-2"). The second choice would be Alternative "a-1" of combined system in which mostly new sewer pipes will be installed.

It shall be noted, however, that thorough implementation of the recommended optimum plan for improvement of the existing sewer network requires huge investment and long term implementation and is subject to further study under the master planning basis for the whole city. In this regard, an exclusion of such overall improvement of the existing sewer network is agreed to be excluded from the scope of preliminary design of this Study between the MOPWT and the Study Team.

**Table 7.4 Comparison of Alternatives for Improvement of Sewer Network**

| Evaluation Item | Importance | Combined System | | Separate System | |
|---|---|---|---|---|---|
| | | a-1 | a-2 | b-1 | b-2 |
| Max. No. of Sewer Lines in One Route | C | One | Double | Double | Triple |
| Contribution to Improvement of River Water Quality | A | Relatively Poor | Relatively Poor | Good | Good |
| Countermeasure to Deterio-rated Sewers and Improvement of Leakage from Sewers | A | Mostly Improved (84 %) | Partially Improved (46 %) | No Improvement (0 %) | Total Improvement (100 %) |
| Improvement of Inundation | B | Improved | Improved | Improved | Improved |
| Flexibility of Implementation | B | Low | High | Fair | Relatively High |
| Difficulty of Construction | C | Good | Difficult | Fair | Difficult |
| Difficulty of Reconnection | C | Difficult | Easy | Easy | Easy |
| Construction Cost | A | 98% | 85% | 80% | 100% |

## 7.4 Sewage Treatment and Disposal

### 7.4.1 Design Conditions of Sewage Treatment Plant

(1) Planned sewage flow:

| | | |
|---|---|---|
| Daily average | 106,000 $m^3$/day | |
| Daily maximum | 106,000 $m^3$/day | |
| Hourly maximum (dry) | 9,670 $m^3$/hour | (= 232,000 $m^3$/day) |
| Hourly maximum (rain) | 26,000 $m^3$/hour | (= 624,000 $m^3$/day) |

(2) Planned water quality:

| | | | | |
|---|---|---|---|---|
| Influent: | $BOD_5$ | 200 mg/l | SS | 200 mg/l |
| Effluent: | $BOD_5$ | 25 mg/l | SS | 35 mg/l |

### 7.4.2 Sewage Treatment Method

The following criteria are applied to select the most appropriate treatment method:

- The selected treatment method shall conform to the effluent quality standards to be adopted by the Albanian Government

- Less cost for construction and O & M (operation and maintenance),
- Less power consumption,
- Easy operation, and
- Easy maintenance.

Referring to the above requirements, comparative evaluation was made for the stabilization pond method, aerated lagoon method and oxidation ditch method.

Among these three alternatives, stabilization pond method was firstly dropped owing to:

- Difficulty to meet the effluent quality standards,
- Necessity of huge land area (about 360 ha) which is almost impossible in the Study Area.

The aerated lagoon method (AL)was then finally selected in comparison with the oxidation ditch method (OD)by following reasons:

(1) Less power requirement: AL : OD = 80 : 100
(2) Less construction cost including land acquisition: AL : OD = 63 : 100
(3) Less operation and maintenance cost: AL : OD = 67 : 100
(4) Higher stability of sewage treatment
(5) Ease in operation and maintenance

### 7.4.3 Location of Proposed Site for Sewage Treatment Plant

Proposed site of sewage treatment plant is selected near the confluent point of the Tirana River and the Old Lana River with an area of 47 ha, through in depth discussion between the MOPWT and the Study Team and repeated site survey. The proposed site so called as "Berxulli" is located at approximately 11.5 km northwest from the center of Tirana City

## 7.5 On-site Treatment/Disposal of Domestic Sewage

On-site treatment/disposal of domestic sewage is an important mean, not only for small rural community, but also for urban household/s unserved by the public sewerage system. The study of on-site treatment/disposal was taken up as an intermediate countermeasure for those un-served households in the Study Area until the proposed sewerage system be serviceable. The study results indicate several technical options for application of the on-site treatment/disposal

methods as well as recommendations on associated problems to help maintain public hygiene and living environment at desirable level.

(1) Septic tank with infiltration as typical method

Systems with septic tank s are the most commonly applied method. After certain treatment in a septic tank, the effluent is usually disposed into the soil by several means. However, the design and size of the infiltration units/facilities play an important role to attain the satisfactory performance of this technical option.

Disposal of treated effluent is usually done by subsurface irrigation with several variations corresponding to the locality and soil conditions. Alternative measures of subsurface filtration are mainly divided into drained sand filter, undrained sand filter and raised sand filter.

(2) Compact aerobic domestic sewage treatment module

As advanced treatment method, there is compact aerobic domestic sewage treatment module which is usually prefabricated at factories.

Although it provides very high treatment efficiency equivalent to the sewage treatment plant of the proposed project, it requires electric motor driven air compressor to maintain aerobic treatment conditions.

(3) Standardization of on-site treatment and its application

In application of on-site treatment method, certain standardization will be indispensable not only from the view point of technical design, but also from the view point of legislative arrangement for massive application to the public. In addition, septage from septic tank shall be removed periodically to keep performance of septic tank. This pertains to provision of facility for final treatment and disposal of removed septage.

# Chapter 8 Overall Plan and Preliminary Design of Sewerage System

## 8.1 Sewage Collection System

### 8.1.1 Improvement of Interceptor Main in Present Service Area

Although the separate sewer system is selected as the most optimum sewage collection method in improving the existing sewer network, it is excluded from the scope of preliminary design since it shall be dealt with under the master planning basis of the whole city.

Therefore, the scope of preliminary design for improvement of existing sewers is focused on interceptor mains with associated storm overflow chambers and storm discharge outlets for the existing combined sewer system. The method of improvement is to replace existing sewers having insufficient flow capacity with new pipes to meet with the planned sewage flow.

The composition of interceptor mains for preliminary design are listed below by their drainage zone.

**Table 8.1 Composition of Interceptor Main for Improvement**

| Zone | Interceptor Main | | Storm Overflow Chamber |
|---|---|---|---|
| | Diameter (mm) | Length (m) | Number (unit) |
| Tirana River | 700 to 1,800 | 1,751 | 4 |
| Center | 1,300 to 1,900 | 2,259 | 3 |
| Lana-North | 900 to 1,400 | 3,567 | 14 |
| Lana-South | 900 to 1,500 | 2,993 | 28 |

### 8.1.2 Trunk Main to Sewage Treatment Plant

Trunk main to convey intercepted sewage to the proposed sewage treatment plant was planned as dual line system, namely Lana River Trunk Main and Tirana River Trunk Main as follows.

**Table 8.2 Composition of New Trunk Main**

| Name | Concrete Pipe | | Box Culvert | |
|---|---|---|---|---|
| | Diameter (mm) | Length (m) | Size (mm) | Length (m) |
| Tirana River Trunk Main | 1,200 to 1,500 | 7,400 | 1,600 x 1,600 | 3,300 |
| Lana River Trunk Main | 1,350 to 1,650 | 10,200 | 1,700 x 1,700 | 3,300 |

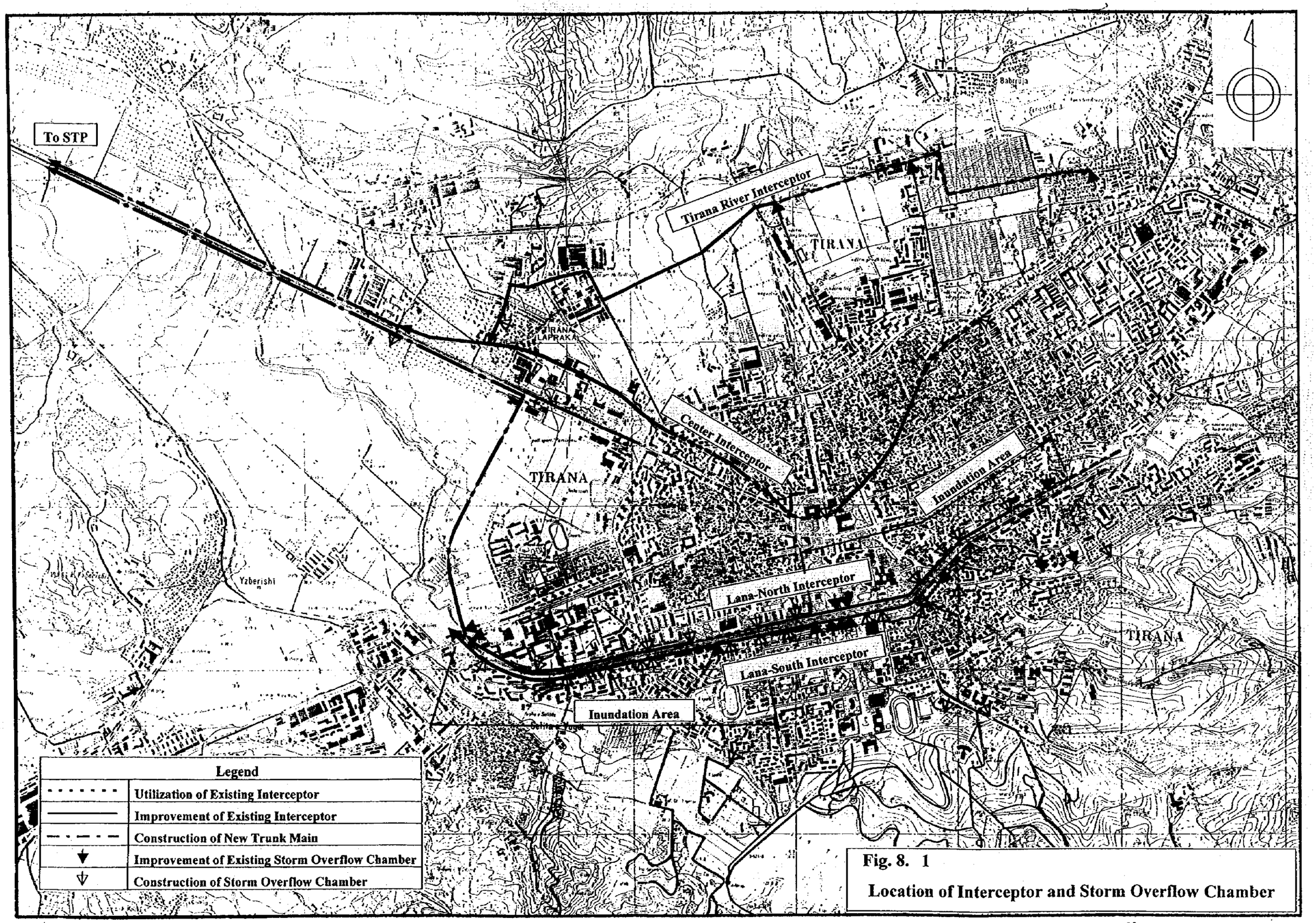



**Fig. 8. 1**

**Location of Interceptor and Storm Overflow Chamber**

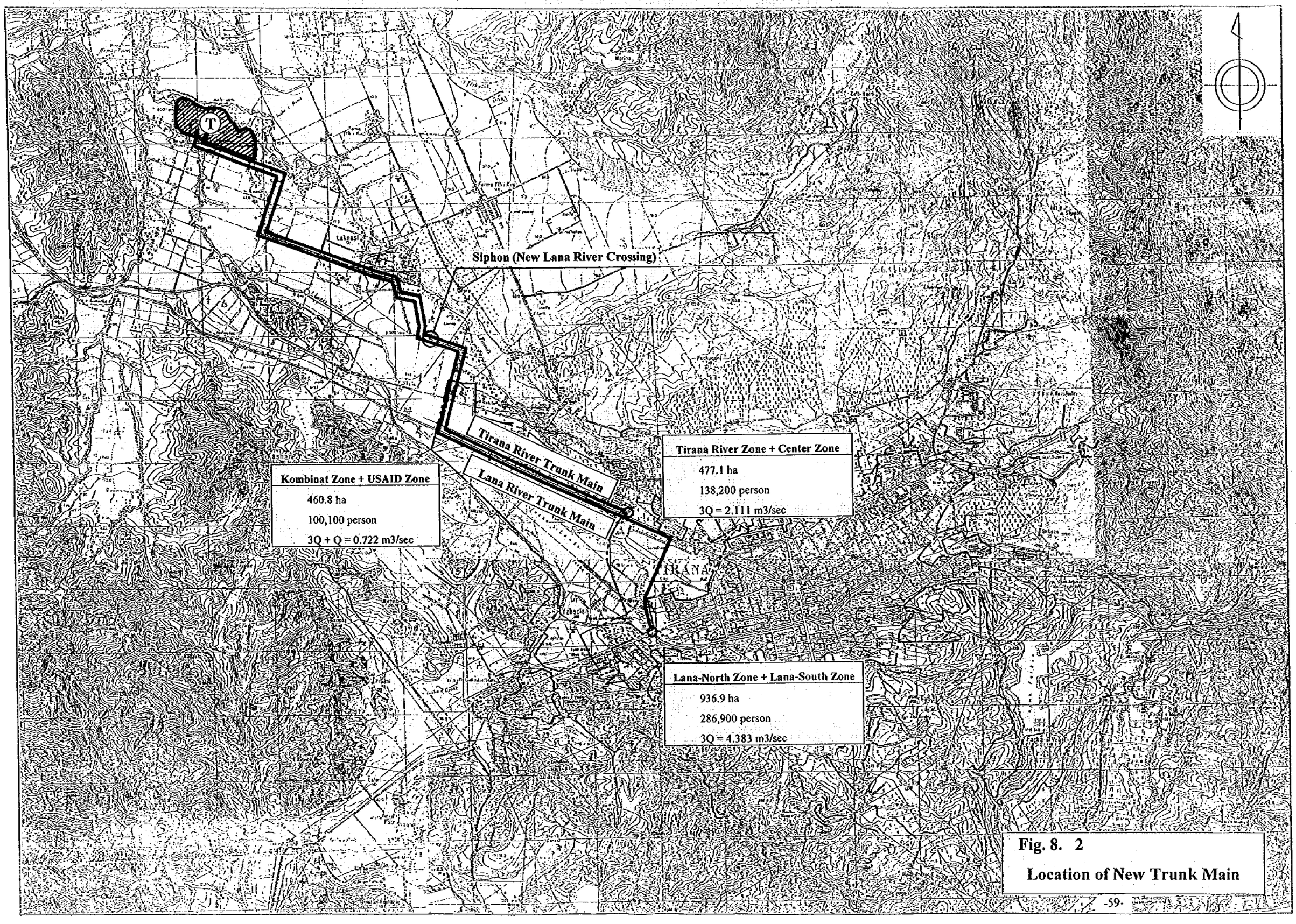



**Fig. 8. 2**

**Location of New Trunk Main**

### 8.1.3 New Main Sanitary Sewer in Expansion Service Area

The sewage collection system for expansion area of sewerage system is designed to be the separate system. In this preliminary design, only main sanitary sewer is taken up since the future land use, particularly road network and housing development, is not clearly defined yet to develop future sewer network. The unit length of main sanitary sewer is assumed to be 50 m/ha.

Specifications of new main sewers in each expansion service area are summarized below.

**Table 8.3 Specifications of New Main Sewers**

| Zone | Area (ha) | Diameter (mm) | Length (m) |
|---|---|---|---|
| Tirana River Zone | 80.3 | 200 to 450 | 4,015 |
| Tirana-South Zone | 94.7 | 200 to 400 | 4,735 |
| USAID Zone | 389.8 | 200 to 700 | 19,490 |

## 8.2 Sewage Treatment Plant

Several candidate sites for sewage treatment plant were evaluated and concluded to be located at Berxulli, 11.5 km northwest of Tirana center or near the confluence of the Old Lana and the Tirana Rivers. Upon final selection of the proposed site, topographic survey and soil investigations were carried out.

In appreciation of the favorable topographic conditions at the proposed site, no lift pump station is required to discharge treated effluent into the Tirana River. Layout of treatment facilities was prepared to fully utilize gravity flow. Storm water is designed to be treated at settling tank to remove suspended materials and then disinfected before disposal to the Tirana River. Stand-by basin was considered for grit chamber, partial mixing aerated lagoon and storm water settling tank for periodical cleaning or removal of sediment. Major treatment facilities are as follows.

Table 8.4 **Composition of Sewage Treatment Facilities**

| Sewage Treatment Facilities | | No. of Units |
|---|---|---|
| 1. Grit Chamber and Screen | | |
| Type | Parallel Flow Type | |
| Dimension | 3.00 mW x 22.00 mL x 1.50 mD | |
| Number of Basin | (stand-by) basins | 8 (2) |
| 2. Complete Mixing Aerated Lagoon | | |
| Type | Rectangular Type | |
| Dimension | 75.00 mW x 104.00 mL x 3.00 mD | |
| Aeration Power Level | 1,120 kW | |
| Retention Time | 1.8 day | |
| Nos. of Basin | basins | 8 |
| 3. Partial Mixing Aerated Lagoon | | |
| Type | Rectangular Type | |
| Dimension | 72.00 mW x 43.00 mL x 4.00 mD | |
| Aeration Power Level | 220 kW | |
| Retention Time | 2.0 day | |
| Number of Basin | basins | 8 |
| Number of Cell | (stand-by) cells | 24 (2) |
| 4. Storm Water Settling Tank | | |
| Type | Rectangular Type | |
| Dimension | 15.00 mW x 38.00 mL x 3.00 mD | |
| Retention Time | 0.54 hour | |
| Number of Basin | (stand-by) basins | 8 (2) |
| 5. Disinfection Tank | | |
| Type | Rectangular Type | |
| Dimension | 5.00 mW x 240.00 mL x 3.00 mD | |
| Retention Time | 15.11 min | |
| Number of Basin | basins | 2 |
| 6. Administration Building | | |
| Type | One story building | |
| Area | 250 $m^2$ | |
| Number of Building | building | 1 |

## 8.3 Staffing Requirement for Operation and Maintenance

A total of 105 personnel is assigned for sewer pipe cleaning under the present staffing set-up of the Enterprise Maintenance of Roads and Sewerage (hereinafter referred to as "EMRS"), as of January, 1997. This staffing set-up owes to the lack of adequate and enough number of maintenance tools and equipment for their assigned work.

Upon implementation of the proposed project, considerable number of personnel will be required at sewage treatment plant, while sewer maintenance will necessitate less number of personnel by introduction of mechanized equipment and tools.

Considering the above mentioned present set-up and actual staffing in other countries, number of personnel required for the operation and maintenance of proposed sewerage system is estimated as follows:

| | |
|---|---|
| Sewage Treatment Plant | 25 persons |
| Sewer Cleaning and Maintenance | 31 persons |
| Total Staffing Requirements | 56 persons |

## 8.4 Project Cost

Project cost of the proposed project was preliminary estimated at approximately 57,073thousand US$ (5,707 million Lek). Breakdown of project cost by major cost component is as follows:

Unit: Thousand US$

| Description | Cost |
|---|---|
| **A. Implementation Cost** | |
| 1. Construction Cost | |
| 1-1 Sewage Collection System | 23,441 |
| 1-2 Sewage Treatment Plant | 13,593 |
| 1-3 Administration Cost | 2,862 |
| Sub-Total | 39,796 |
| 2. Procurement of Maintenance Equipment | 1,233 |
| 3. Engineering Service | 3,300 |
| **Total of Implementation Cost** | **44,329** |
| **B. Common Expenses** | |
| 1. General & Administrative Expenses | 600 |
| 2. Land Acquisition | 4,700 |
| **Total of Common Expenses** | **5,300** |
| **C. Contingency** | **7,444** |
| **TOTAL PROJECT COST** | **57,073** |

(5,707 million Lek)

Note: Exchange rate; 1.0 US$ = 100 Lek (as of January, 1997)

# Chapter 9 Priority Project

## 9.1 Identification of Priority Project

Through the field investigation and evaluation, the serious problems in the existing sewerage system from view point of the urban environment are identified as:

1) Pollution of the Tirana and Lana Rivers due to the discharge of raw sewage, solid waste and industrial/agricultural wastes without any treatment.
2) Leakage of sewage from the sewer network.
3) Inundation/submergence of the road by the storm water.

Since a rapid growth in the city in recent years and inadequate maintenance provisions have resulted in a substantial deterioration in the environment of the city as well as the urban infrastructure.

Considering the above mentioned present situation in Tirana, it is concluded that an urgent project should be focused on to mitigate the environmental problem of the city. Among the whole of sewerage planning area, Lana north and south zones which have present population of 225,332 should be entitled as the target area of the priority project to attain the solution of the above mentioned problems. In addition, Shkoza, Selita e Vogel and Kombinat areas shall be included in the priority target area for expansion of the service area of the existing sewerage system in due consideration of their local conditions.

Scope of priority project are defined as follows:

1) Construction/Improvement of the Sewer Pipes
   - To improve and construct interceptor main and associated storm overflow chambers and storm discharge outlets
   - To construct the trunk main
   - To construct of main sewer for expansion area
   - Urgent countermeasures to mitigate the inundation
2) Construction of the sewage treatment plant
3) Procurement of the sewer cleaning/maintenance equipment

## 9.2 Planning Area, Population and Sewage Flow

To achieve the above mentioned objectives, target year of priority project is set forth in 2001.

| Zone | Area (ha) | | | Population (person) | | |
|---|---|---|---|---|---|---|
| | Existing | Expansion | Total | Existing | Expansion | Total |
| Lana-North | 396.4 | - | 396.4 | 124,900 | - | 124,900 |
| Lana-South | 380.6 | 65.2 | 445.8 | 115,100 | 14,000 | 129,100 |
| Total | 777.0 | 65.2 | 842.2 | 240,000 | 14,000 | 254,000 |

Planning area and its population of priority project by sewerage service zone are as follows:

Planned sewage flow at treatment plant at daily average basis is estimated at 50,800 $m^3$/day.

## 9.3 Sewage Collection System

(1) Improvement and construction of interceptor main and associated storm overflow chambers and storm discharge outlets

The target interceptor mains are located along the Lana River in Lana-North and Lana-South zones. The number of required number of storm overflow chambers are likewise determined to be 33 units (14 units in Lana-North zone and 19 units in Lana-South zone).

(2) Construction of the trunk main

Lana River trunk main

(3) Construction of main sewer for expansion area

Shkoza, Selita and Kombinat areas in Lana-South zone.

(4) Urgent countermeasures to mitigate the inundation

Inundation areas in Lana-North and Lana-South zones.

The Tirana River zone is excluded from this countermeasure since urbanization is not so progressive and number of households suffered from inundation are very limited. Center zone is also excluded since it requires thorough improvement of sewer system and is not suitable for urgent project.

Countermeasures to be taken up in the priority project to mitigate inundation on roads is to construct large scale storm water inlets at both sides of roads to drain surface run-off and

discharge it into the Lana River. A total of 36 storm water inlets will be located with 100 m interval at 17 locations for about 1.6 km span in Lana-North zone and 19 locations for about 1.8 km span in Lana-South zone.

## 9.4 Sewage Treatment Plant

Design conditions of priority project are same as the foregoing preliminary design of the whole sewerage system. Planned sewage flow and quality are as follows:

1) Planned sewage flow

| | | |
|---|---|---|
| Daily Average | 53,000 $m^3$/day | |
| Daily Maximum | 53,000 $m^3$ /day | |
| Hourly Maximum (Dry) | 4,770 $m^3$/hour | (= 115,000 $m^3$/day) |
| Hourly Maximum (Rain) | 14,290 $m^3$/hour | (= 343,000 $m^3$/day) |

2) Planned sewage quality

| | | | | |
|---|---|---|---|---|
| Influent: | $BOD_5$ | 200 mg/l | SS | 200 mg/l |
| Effluent: | $BOD_5$ | 25 mg/l | SS | 35 mg/l |

A half size of the proposed sewage treatment plant will be required for the priority project.

## 9.5 Staffing Requirement for Operation and Maintenance

For operation and maintenance, the following staffing will be required:

| | |
|---|---|
| Sewage Treatment Plant | 18 persons |
| Sewer Cleaning and Maintenance | 31 persons |
| Total Staffing Requirements | 49 persons |

## 9.6 Project Cost

Project cost for priority project is estimated as follows:

Unit: Thousand US$

| Description | | | Cost |
|---|---|---|---|
| **A.** | **Implementation Cost** | | |
| | 1. | Construction Cost | |
| | 1-1 | Sewage Collection System | 13,174 |
| | 1-2 | Sewage Treatment Plant | 7,001 |
| | 1-3 | Administration Cost | 1,431 |
| | | Sub-Total | 21,606 |
| | 2. | Procurement of Maintenance Equipment | 1,078 |
| | 3. | Engineering Service | 1,800 |
| | | **Total of Implementation Cost** | **24,484** |
| **B.** | **Common Expenses** | | |
| | 1. | General & Administrative Expenses | 300 |
| | 2. | Land Acquisition | 2,600 |
| | | **Total of Common Expenses** | **2,900** |
| **C.** | **Contingency** | | **4,108** |
| | | **TOTAL PROJECT COST** | **31,492** |

(3,149 million Lek)

Note: Exchange rate; 1.0 US$ = 100 Lek (as of January, 1997)

# Chapter 10 Operation and Maintenance Program

## 10.1 General

Appropriate operation and maintenance (O & M) of sewerage facilities are indispensable not only to keep up the performance of public sewerage service, but also to prolong service life of the overall sewerage system. For new sewerage facilities, emphasis shall be placed on the importance of preventive maintenance, rather than the repair/rehabilitation of damaged facilities. For existing sewer pipes, periodical repair/replacement shall be considered in the regular program from the view point of their service life.

In the O & M program, scope of activities, institutional set-up, task description and o & M procedures are identified for both sewage collection system and sewage treatment plant. It shall be emphasized that these descriptions are considered as the minimum requirements to attain the desirable O & M practices and further development of O & M activities be subject to rely on the progress of human resource development in this particular field.

Utilization of private sector shall be determined not only from economic view, but also from importance and liability of the work.

## 10.2 Sewage Collection System

### 10.2.1 Procedure of Operation and Maintenance

There are three procedures of O & M namely, site investigation, pipe cleanings and rehabilitation of damaged sewers. The work items by O & M procedure are presented in Table 10.2.1.

**Table 10.2.1 Work Items by Type of O & M of Sewer**

| O & M Type | Working Items |
|---|---|
| Site investigation | - Identification of damage and blockage location<br>- Identification of the percolation point of groundwater<br>- Investigation of the overflow point at manhole<br>- Measurement of the volume of settled soil at the sewer bottom |
| Pipe cleaning | - Removal of settled soil, silt and foreign matters |
| Rehabilitation | - Replacement/repair of damaged sewer |

The O & M for sewer should be conducted by the working program as shown below.

(1) Site investigation

Annual investigation plan shall be prepared to cover the entire sewer network in the service area. In carrying out of survey work, safety precautions shall be due followed to avoid anoxia and other human hazards.

This annual survey shall be repeated year-by-year and historical record shall be kept as reference for future renovation/rehabilitation.

2) Pipe cleaning program

Annual pipe cleaning program shall also be prepared to cover the whole sewer network. Priority route/section of pipe cleaning shall be identified through the above mentioned investigation and historical record.

Generally, there are four types of pipe cleaning methods: high pressure jet cleaning machine, vacuum machine, bucket machine and manual type. A method using a high pressure jet cleaning machine and a vacuum machine is recommendable in consideration with good quality of maintenance work. Necessary equipment and their purpose are also identified.

3) Rehabilitation plan

The annual pipe rehabilitation plan should be prepared for damaged sewers and be conducted from the priority spot based on the site investigation results. Annual plan shall take into account the forthcoming service life termination of existing sewers.

Generally, there are two types of rehabilitation works, namely replacement of damaged sewers and repair of a part of damaged sewers. The pipe rehabilitation for damaged sewers should be contracted with local contractors according to the annual plan and when damaged sewer were found. Director of sewer maintenance should direct the contractors to prepare a report on the damaged conditions, causes of damage, countermeasures for damage and rehabilitation time for future O & M.

### 10.2.2 Organization for Operation and Maintenance

Proposed staff number for preventive maintenance is 31 persons as shown in Table 10.2.2, while the present number is 105 persons for sewer reticulation.

**Table 10.2.2 Required Total Staff Number for O & M of Sewage Collection System**

(unit: persons)

| Position | | Number | Duty |
|---|---|---|---|
| Director | | 1 | Responsible for maintenance of sewer collection system |
| Sewer | Manager | 1 | Responsible for cleaning of sewers |
| | Foreman | 2 | Responsible for site works of each zone (east and west zones) |
| | Worker | 8 | 4 workers/team x 2 teams |
| | Driver | 4 | 2 workers/team x 2 teams |
| Stormwater Inlet | Manager | 1 | Responsible for cleaning of storm water inlet |
| | Foreman | 1 | Responsible for site works |
| | Worker | 6 | 3 workers/team x 2 teams |
| | Driver | 2 | 2 workers/team x 2 teams |
| Vehicle Maintenance | Mechanic | 3 | Maintenance of vehicles/equipment |
| | Driver | 2 | Operation of vehicles/equipment |
| Total | | 31 | |

## 10.3 Sewage Treatment Plant

Aerated lagoon method adopted for sewage treatment requires simple technology and less manpower for operation and maintenance. Proper operation and maintenance is, however, indispensable to attain the design treatment efficiency and to maximize the service life of sewerage facilities.

O & M activities in the treatment plant are generally divided into sewage treatment and sludge treatment/disposal. Sewage is continuously treated by aerated lagoon, while sludge is treated by natural drying and then hauled to be dispose at sanitary landfill site.

### 10.3.1 Work Program for Operation and Maintenance

Work program for O & M is classified into two major categories; daily and periodical work as shown below.

**Table 10.3.1 Work Items of Sewage Treatment Plant by O & M Types**

| O & M Work | Working Items |
|---|---|
| Daily work | - Measurement of inflow sewage volume<br>- Removal of screenings at screen<br>- Inspection of operation of aerators<br>- Inspection of operation of chlorination facilities<br>- Inspection of operation of electrical facilities |
| Periodical work | - Removal of grit and sediments at grit chamber (monthly)<br>- Removal of sludge at partial mixing lagoons/storm water settling tanks (annually)<br>- Inspection/repair of mechanical/electrical facilities (annually)<br>- Overhaul of mechanical/electrical facilities (every 5 to 10 years) |

(1) Daily work program

The measurement of inflow volume is significant work item for proper operation of sewerage facilities through the future. The screenings, soil, silt, and other substances collected at the screen and grit chamber have to be removed every day. These substances should be collected at the site in the plant and conveyed to the solid waste dumping site for final disposal by sanitary landfill. The inspection during operation of mechanical/electrical facilities is also very important item to notice any defect and to take immediate countermeasure.

The required staff number in sewage treatment plant are shown below.

| | |
|---|---|
| AM 8:00 to PM 4:00 | one (1) Engineer and two (2) Operators |
| PM 4:00 to AM 0:00 | one (1) Foreman and two (2) Operators |
| AM 0:00 to AM 8:00 | ditto |
| Standby | ditto |

(2) Periodical work program

Two types of maintenance staff are required for periodical work program. The first group is ordinary workers to remove sludge in lagoons and tanks as well as cleaning in the plant, whereas the second group is technicians for maintenance of mechanical/electrical facilities.

(3) Sludge disposal

The sludge from partial mixing aerated lagoons and stormwater settling basins will be treated by natural drying and removed with the use of a wheel loader and a dump truck seasonally. In principle, the removed sludge will be disposed of in solid waste dumping site or landfill site.

As the sludge may contain toxic substances originating in industrial wastewater, special attention should be paid to sludge disposal in agricultural field.

(4) Laboratory

The new treatment plant will discharge the treated water into the Tirana River, but the treated water will have to comply with strict effluent regulations. Because the quality of the treated water will need to be checked immediately as required, a laboratory will be facilitated within the plant, upon the addition of a chemist to the permanent staff. Complicated water quality analysis will, however, be conducted by contract.

Water quality indices and analysis frequency are also identified.

### 10.3.2 Organization for Operation and Maintenance

Proposed staff number for operation and maintenance is 18 persons for Phase 1 and 25 persons for Phase 2, as shown in Table 10.3.2, while the present number is 105 persons for sewer reticulation.

**Table 10.3.2 Required Number of Staff for O & M of Sewage Collection System**

| Field & Position | | Phase 1 | Phase 2 | Duty |
|---|---|---|---|---|
| Director | | 1 | 1 | Responsible for sewage treatment plant |
| Operation | Manager | 1 | 1 | Responsible for operation |
| | Engineer | 2 | 2 | Responsible for technical matters |
| | Foreman | 3 | 3 | Responsible for operation of each shift |
| | Operator | 4 | 8 | 1 (2) operator/shift x 4 shifts |
| Maintenance | Manager | 1 | 1 | Responsible for maintenance |
| | Engineer | 2 | 2 | Responsible for mechanical and electrical |
| | Technician | 1 | 2 | Responsible for site works |
| | Worker | 2 | 4 | Cleaning |
| Water Analysis | Chemist | 1 | 1 | Water quality control |
| Total | | 18 | 25 | |

## 10.4 Operation and Maintenance Cost

The operation and maintenance program, as stipulated in the preceding sections, requires the following annual costs.

**Table 10.4.1 Operation and Maintenance Cost**

(Unit: US $/year)

| Item | Phase 1 | Phase 2 |
|---|---|---|
| Sewage Collection System | | |
| - Personnel Expenses | 111,600 | 111,600 |
| - Fuel Cost | 28,013 | 28,013 |
| Sub-Total | 139,613 | 139,613 |
| Sewage Treatment Plant | | |
| - Personnel Expenses | 64,800 | 90,000 |
| - Electricity Cost | 210,240 | 407,340 |
| - Chemical Cost | 60,833 | 109,500 |
| - Repair Cost | 32,000 | 60,000 |
| Sub-Total | 367,873 | 666,840 |
| Total | 507,486 | 806,453 |