No.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

GENERAL DIRECTORATE OF WATER SUPPLY AND SEWERAGE (DPUK)
MINISTRY OF PUBLIC WORK, TRANSPORT AND
TELECOMMUNICATION (MoPWTT), THE REPUBLIC OF ALBANIA

THE STUDY ON THE DEVELOPMENT PLAN FOR SEWERAGE SYSTEM AND SEWAGE TREATMENT PLANT FOR GREATER TIRANA IN THE REPUBLIC OF ALBANIA

FINAL REPORT

Volume III : Supporting Report

MARCH 2007

NIHON SUIDO CONSULTANTS CO.,LTD.

TOKYO ENGINEERING CONSULTANTS CO.,LTD

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JR
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Exchange Rate

Exchange Rate Applied for Master Plan (Date of Application: November 1, 2005)
1 US Dollar = Lek 107.23 = Yen 115.74
1 Euro = Lek 129.463

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1 US Dollar = Lek 96.28 = Yen 115.13
1 Euro = Lek 122.96

Final Report

Volume I:	**Executive Summary**
Volume II:	**Main Report**
Volume III:	**Supporting Report (This volume)**

PREFACE

In response to a request from the Government of the Republic of Albania, the Government of Japan decided to conduct a study on “The Study on the Development Plan for Sewerage System and Sewage Treatment Plant for Greater Tirana in the Republic of Albania” and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Harutoshi Uchida of NIHON SUIDO CONSULTANTS Co., LTD. and consisted of experts from NIHON SUIDO CONSULTANTS Co., LTD. and TOKYO ENGINEERING CONSULTANTS CO., LTD. between July 2005 and August 2006. In addition, JICA set up an advisory committee headed by Ms. Hiroko Kamata, Senior Advisor, Institute for International Cooperation, JICA, which examined the study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of the Republic of Albania and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Albania for their close cooperation extended to the study.

March 2007

Ariyuki Matsumoto
Vice President
Japan International Cooperation Agency

March, 2007

Ariyuki Matsumoto
Vice President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

Dear Sir,

We are pleased to submit this Final Report on the Study on the Development Plan for Sewerage System and Sewage Treatment Plant for Greater Tirana in the Republic of Albania. This report incorporates the views and suggestions of the authorities concerned of the Government of Japan, including your Agency. It also includes the comments made on the Draft Final Report by General Directorate of Water Supply and Sewerage and Ministry of Public Work, Transport and Telecommunication of the Government of the Republic of Albania and other government agencies concerned of the Republic of Albania.

The Final Report comprises a total of three volumes as listed below.

Volume I:	Executive Summary
Volume II:	Main Report
Volume III:	Supporting Report

The report contains the Study Team's findings, conclusions and recommendations derived from the two phases of the Study. The main objective of the Phase 1 was to collect data and analysis and formulate a master plan and to identify a priority project, whilst that of the Phase 2 Study was to examine the feasibility of the priority project which had previously been identified in Master Plan during the course of the Phase 1 Study.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs and the Ministry of Land, Infrastructure and Transport of the Government of Japan for their valuable advice and suggestions. We would also like to express our deep appreciation to the General Directorate of Water Supply and Sewerage and Ministry of Public Work, Transport and Telecommunication, and other agencies of the Republic of Albania for their cooperation and assistance extended to us throughout our Study.

Very truly yours,

Harutoshi UCHIDA, Team Leader
Study on the Development Plan for Sewerage
System and Sewage Treatment Plant for
Greater Tirana in the Republic of Albania

The Study on the Development Plan for Sewerage System and Sewage Treatment Plant for Greater Tirana in the Republic of Albania

Final Report

Volume III: Supporting Report

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Abbreviations

AL	Aerated Lagoon
ATP	Affordability-to-pay
AWSSA	Association of Water Supply and Sewerage Enterprises of Albania
BOD_5	Biochemical Oxygen Demand
BWI	Berlin Water International
BMZ	German Federal Ministry for Economic Cooperation and Development
C/P	Counterpart
COD	Chemical Oxygen Demand
DPUK	General Directorate of Water Supply and Sewerage
DWF	Dry Weather Flow
EBRD	European Bank for Reconstruction and Development
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EU	European Union
FC	Foreign Currency
F/S	Feasibility Study
GoA	Government of the Republic of Albania
GoJ	Government of Japan
GTW&SA	Greater Tirana Water & Sewerage Authority
IEE	Initial Environmental Examination
JICA	Japan International Cooperation Agency
LC	Local Currency
LG	Local Government
M/M	Minutes of Meeting
M/P	Master Plan
MDGs	Millennium Development Goals
MIS	Management Information System
MoE	Ministry of Economy
MoEFWM	Ministry of Environment, Forests and Water Management
MoF	Ministry of Finance
MoI	Ministry of Interior
MoPW	Ministry of Public Works
MoPWTT	Ministry of Public Works, Transport & Telecommunications
MoTAT	Ministry of Territorial Adjustment and Tourism
MWWP	Municipal Water and Wastewater Project
NEAP	National Environmental Action Plan
NGO	Non Government Organization
NRA	National Regulatory Agency (Water Sector)
NWC	National Water Council
PIU	Project Implementation Units
PSP	Private Sector Participation
RAWSS	Rural Agency for Water Supply & Sanitation
REAs	Regional Environmental Agencies
SAp	Stabilization & Association Process
SC	Supervisory Councils
SSI	State Sanitary Inspectorate
STP	Sewage Treatment Plant
TAC	Territorial Adjustment Council
UKK	Water Supply and Sewerage Enterprise of Kamza

UKT	Water Supply and Sewerage Enterprise of Tirana
VWSE	Village Water Supply Enterprise
WTP	Willingness-to-pay
WWF	Wet Weather Flow

Appendix 1
List of References

Appendix 1 List of References

List of References

No	Title	Source	Publication Date
1	The Study on the Sewerage System in Metropolitan Tirana in the Republic of Albania – Final Report - Summary	Nippon Jogesuido Sekkei Co Ltd Tohmatsu & Co.	March 1998
2	The Study on the Sewerage System in Metropolitan Tirana in the Republic of Albania – Final Report – Main Report Chapters 5, 12, 14, 15, 16	Nippon Jogesuido Sekkei Co Ltd Tohmatsu & Co.	March 1998
3	Rapid Land & Infrastructure Assessment (Urban Land Management Project – Background studies: Strategic Plan for Greater Tirana)	PADCO Valu Add Consultants/DGI Mix Tech	Aug 2001
4	Strategic Plan for Greater Tirana Vol 1 Main Report Urban Land Management Project (Draft)	PADCO for Min of PW Financed by IDA	1 Feb 2002
5	Joint IDA-IMF Assessment of the Poverty Reduction Strategy Paper Annual Progress Report	World Bank	Jun 2003
6	Albania Water supply and Wastewater Sector Strategy (with support of World Bank)	Ministry of Regulatory Adjustments & Tourism	September 2003
7	Albania – Integrated Water & Ecosystem Management Project (Project Document)	World Bank GEF	Feb 2004
8	Compendium of Environmental Legislation of Albania	Rep. of Albania Min. o Environment	March 2004
9	On progress toward achieving the Millennium Development Goals	Albania National Report (with UN)	2004
10	Heading Towards Efficient Municipal Water Services (Conference Documentation support from KfW)	Min of Territorial Adjustments & Tourism	March 2004
11	Compendium of Environmental Legislation of Albania	Min. of Environment	March 2004
12	MASTER PLAN Second update (Italian Cooperation)	Tiana Acque (s.c.a.r.l.)	Sep 2004
13	PP Presentation – Outline of JICA Project	JICA StudyTeam	Aug 2005
14	Excerpts taken from the Albanian Govt. program related to the Water Supply and Sewage Sector 2005-2009 (submitted to National Assembly)	Min o TAT (with GTZ)	Sep 2005
15	MASTER PLAN Third update (Italian Cooperation)	Tiana Acque (s.c.a.r.l.)	Sep 2005
16	Water Vision Beyond Supply Conference Documentation	Water Supply & Sewerage Association of Albania	19-21 Oct 2005

17	Second mission, Feb 15-17th. "Decentralization Water & Wastewater Greater Tirana"Interviews with Mayors of surrounding municipalities	Thilo Steinbach, GTZ Consultant	Feb 20 2006
18	Spring 2006 Water Policy conference Conference Program Documentation Decentralization of Government & Regionalization of Water Supply & Wastewater Services Policy Challenges & Opportunities, World Experiences etc-Successes & Failures	Water Supply & Sewerage Association of Albania	12 April 2006
19	Spring 2006 Water Policy Conference Consensus of the Conference Attendees Signed Document	MoPWTT AWWA MoI (Local Government)	27 April 2006
20	Comparative Study of Aggregation Policies For Water & Sanitation Provision	GTZ Water Program Manager	May 2006
21	Decentralization of Government & Regionalization of Water Supply & Wastewater Services Policy Challenges & Opportunities	GTZ Newsletter	May 2006
22	Agriculture, Livestock, Agro-industry, Fishery, Forestry, Ministry of Agriculture and Food	Ministry of Agriculture and Food	2004
23	Bulletin 2003	Tirana Municipality	2003
24	Komente per studimin e cilesise se ajrit ne Shqiperi, viti 2004	MoEFWM	2004
25	Përmbledhja e monitorimeve për cilësinë e ajrit dhe ujrave si dhe niveli i zhurmave, Monitorim vitin 2005	MoEFWM	2005
26	The Environmental Aspects Study of the Tirana-Durres Hilly Area	MoEFWM	2005
27	The Statistical Yearbook 1991-1999	INSTAT	2002
28	Compendium of Environmental Legislation of Albania	MoE	2004
29	Updated National Environmental Action Plan 2001	MoE	2005
30	Environmental Performance Review of Albania	Economic and social Council, United Nations	2002
31	Albania Poverty Assessment	The World Bank, Report No. 26213-AL	November 5, 2003
32	The Economics of Project Analysis –A Practitioner's Guide –	The World Bank, EDI Technical Materials	1991
33	Millennium Development Goals -Global Target - Local Approaches- Tirana Regional Report	UNDP Albania	2003
34	Design Manual for Water Supply and Treatment	The Environment Protection Agency (EPA), USA	1999

Appendix 2

River Survey and river management

Appendix 2 River Survey and River Management

2.1 River planning

2.1.1 Zone wise division of a river

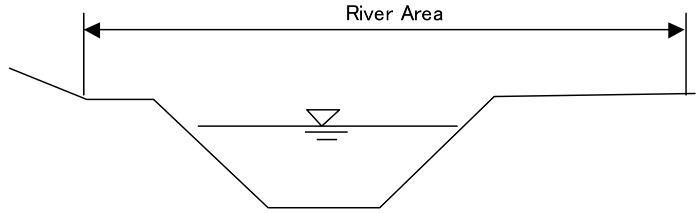
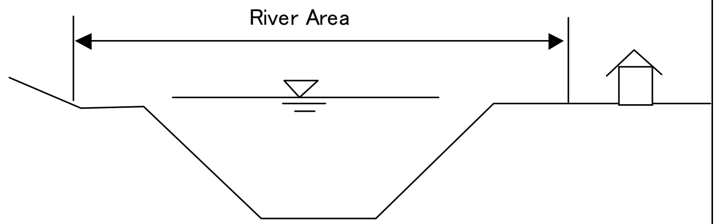
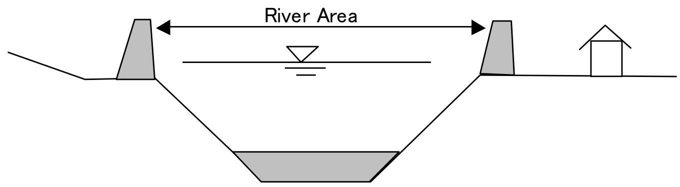
A river is divided into upstream, midstream and downstream. Each fraction has its characteristics as follows.

(1) Upstream

Since the upstream part of a river has a steep inclination, flow velocity there is high and erosion easily occurs. Consequently, riverbed becomes considerably lower than the ground level and the capacity of flow is large. As a result, river water rarely overflows the river itself.

(2) Midstream

A river has smaller inclination at its midstream than at the upstream. Therefore, flooding occasionally occurs. The damage by flooding is not serious, since the area near the river is not inhabited under these circumstances. However, repeated flooding makes the riverbed deeper, and flooding tends to occur less frequently. The area near the river will be inhabited for less frequent flooding. As a result, the river area becomes smaller and the sands flown from upstream are deposited, which leads to the shallow riverbed. The capacity of flow is also lowered and river bank is needed for flood prevention.

First Stage No residence near the river	
Second Stage Residence near the river	
Third Stage River needs bank	

Lana River is currently at the second stage in the above figure. Tirana River is also nearly at the second stage, but the downstream area of the confluence of Tirana and Lana Rivers is not densely inhabited and is supposed to be at the first stage at present. However, the area currently used for agriculture has been occupied by houses year by year and is approaching the second stage.

(3) Downstream

The downstream area has the very small inclination resulting in small flow velocity. The conveyed sands are deposited, which forms swamp and/or plains. The sea water level in the area is often higher than that of ground level or the river water level is often higher than that of the ground level due to the deposited sands. These situations necessitate the construction of river banks to protect the inhabited areas.

2.1.2 Rivers in the planning area

Two rivers of Lana and Tirana flow in the planning area. These two rivers are at their midstream in the planning area and their river bed gradient is more than 0.4 %. Therefore, their flow velocities are comparatively large and their channel areas are also comparatively large due to erosion by river water. In other words, these rivers are natural ones or excavated ones with no banks. Even if these rivers cause flooding, the flooded area is limited to the area near the rivers and the damage is very small.

Though river improvement is not urgently needed, the required river section is temporarily calculated here to cater for a certain flow estimated for given catchment area, rainfall intensity, runoff coefficient and so forth. Flow estimate method is described below according to its procedure.

2.1.3 Calculation of river section

(1) Flow formula

Three methods shown below are used to calculate river flow using the rainfall in the basin.

- Rational Formula
- Storage function a
- Unit hydrograph

The rational formula shown below is applied here for its simplicity and easy understanding of coefficients.

$$Q = \frac{1}{360} CIA$$

where, Q is flow rate in qu.m/sec,

C is runoff coefficient,

I is rainfall intensity in mm/hour and

A is catchment area in hectares.

Runoff coefficient is the ratio of the flow on the ground to the total rainfall and varies depending upon ground conditions. The Study applies the coefficients commonly used in river planning, or 0.5 for flat areas and 0.5 for mountain areas. But in sewerage planning,0.1 to 0.2 for mountain area is adapted.

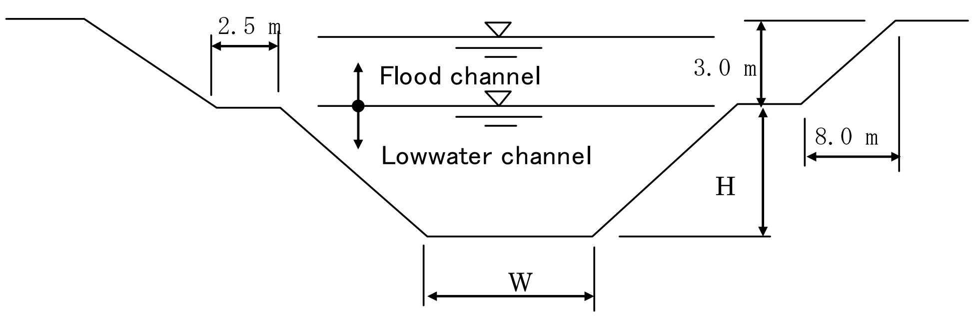
(2) Rainfall intensity

Design rainfall intensity is calculated for each return period by analyzing the data on past rainfall intensity. The previous JICA Study in 1998 calculated the intensity by applying n/N instead of n/(N+1), which makes the difference between two studies shown below.

Rainfall intensity

Return Period	Previous JICA Study	This Study
1	$I=\frac{2,150}{t+18}$	$I=\frac{2,240}{t+18}$
2		$I=\frac{2,500}{t+17}$
2.5	$I=\frac{2,520}{t+17}$	
4	$I=\frac{2,750}{t+17}$	$I=\frac{2,780}{t+16}$
5	$I=\frac{2,870}{t+16}$	$I=\frac{2,870}{t+16}$
10	$I=\frac{3,270}{t+16}$	$I=\frac{3,150}{t+15}$
30		$I=\frac{3,600}{t+13}$

Return period is set to be 1 year and 30 year. The shapes of lowwater channel are designed to flow the calcurated flowrate (1 year return period). For the 30 year return period, the water level will be considered.



(3) Catchment area and length of channel

Boundaries of catchment areas are set on the map referring to the contour lines. The river is divided into several blocks taking the flowing tributaries into account. Then, the area and the length of each block are measured on the map. Urban and green areas are separately measured because the runoff coefficient depends upon ground conditions. Lana River is divided into four blocks and Tirana River into three. The following table shows the area and the length of channel of each block.

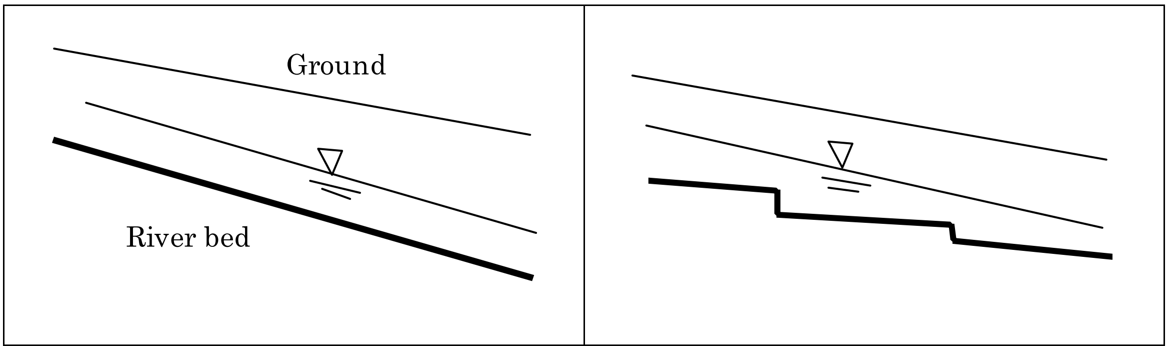
The area and the length of channel

Block	Area of flat land (ha)	Mountain area (ha)	Length of channel (km)
L1	240	1,140	4.8
L2	740	920	4.8
L3	1,810	40	3.8
L4	2,710	550	4.2
T1	190	5,410	8.0
T2	1,800	1,600	8.9
T3	2,560	0	6.5

L for Lana River and T for Tirana River

(4) Slope of riverbed

Riverbed level and the length of the block are read on the map, and the slope in the block is calculated. Design riverbed slope is set smaller than the calculated value, because the greater slope makes the riverbed separate from the ground level.



Ground Slope<River Bed Slope | Ground Slope>River Bed Slope

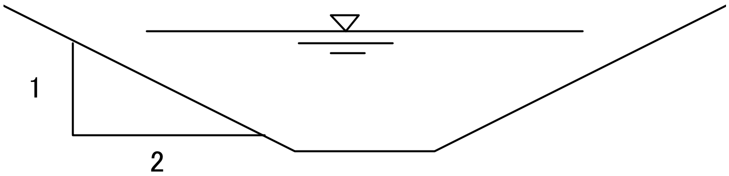
Present riverbed slope and design riverbed slope in each block are shown in the following table.

Present and design riverbed slopes

Block	Present riverbed slope	Design riverbed slope
L1	6.6	6.0
L2	6.2	6.0
L3	4.5	4.0
L4	3.0	3.0
T1	10.9	8.0
T2	4.2-8.0	4.5
T3	4.5	4.0

(5) Setting of river section

Trapezoid, which is applied to improved Lana River, is also applied as design river section. The slope of the bevel is set two to one. By applying this slope, water level raise can be avoided even if the river flow exceeds the design value, which means the safer section against the possible flood.



(6) Velocity formula

Manning formula is applied as velocity formula which is commonly applied in sewerage and river planning.

$$v = \frac{1}{n} R^{2/3} I^{1/2}$$

$$Q = A\,v$$

Where, v is velocity (m/s),
n is roughness coefficient (0.025),
I is slope,
A is area (m^2) and
Q is flow rate(m^3/s).

(7) Concentration time

Concentration time is the total of inlet time, or the time necessary for the storm water to flow from the most upstream point to the nearest sewer, and the time of flow to a certain point of the sewer to consider. In a certain fraction of channel, the time of flow for the fraction is calculated using the flow velocity obtained from design section and the slope.

$$T = L/(60v)$$

Where, T is inlet time in minutes,
L is length of river in meter and
V is flow velocity of river in m/s.

For the upstream part where no river section is designed, concentration time is set using Carbay Formula.

$$T = (2/3 * 3.28 * L * 0.6 / S^{0.5})^{0.467}$$

Where, T is concentration time,
L is length of channel in m and
S is slope of channel

(8) Results of calculation

The calculated concentration time of t is applied to rainfall intensity formula with one year return period to obtain rainfall intensity as follows.

$$I = \frac{2{,}240}{t + 18}$$

The rainfall intensity is then substituted to rational formula to calculate the flow and the design river section (lowwater channel) to cover the flow. The velocity in each fraction is calculated for the corresponding design section and the slope.

The calculated flow and the section are shown below.

River flow and design river section

Brock	Flow rate(m^3/s)	River Shape (m)	Flow Area (m^2)
L1	28.014	10.0 / 4.0 ×1.5	10.5
L2	53.200	12.0 / 6.0 ×1.5	13.5
L3	61.387	14.0 / 6.0 ×2.0	20.0
L4	74.504	18.0 / 10.0 ×2.0	28.0
T1	86.240	14.0 / 6.0 ×2.0	20.0
T2	115.200	21.0 / 13.0 ×2.0	34.0
T3	192.888	31.0 / 23.0 ×2.0	54.0

(9) Flowrate for 30 year return period

For the rainfoll of 30 year return period, the flowrates of river are calcurated as following.

Rainfall intencity

$$I = \frac{3,600}{t + 13}$$

Velocity of the river

The velocity is assumed 1.2 times to the 1 year return period.

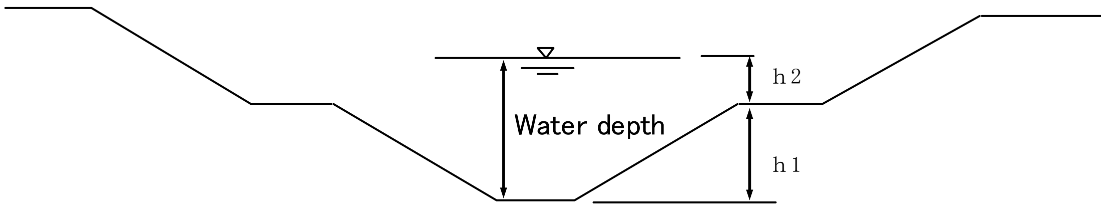
Roughness coefficient 0.030 (Flood channel is covered with grasses. Then its value is higher than lowwater cannnel.)

The shape of flood area is assumed same as existing reformed Lana River. The water level for 30 year return period is obtained as following table. The depth of the river will be 2.4m to 3.1m.

Water depth

Brock	Flow rate(m^3/s)	h1(m)	h2(m)	Depth(m)
L2	92.416	1.5	0.9	2.4
L3	107.525	2.0	0.9	2.9
L4	132.392	2.0	0.9	2.9
T1	146.160	2.0	0.8	2.8

T2	199.800	2.0	0.9	2.9
T3	336.708	2.0	1.1	3.1



The actual river section is greater than the design one used in the calculation and the present riverbed is four to five meters below the ground level. Therefore, it is judged that the actual river has the sufficient capacity of flow. In the last winter, river section survey was done, and then the water level for 30 year return period rainfall has been obtained as same method.

2.2 Recommendation

2.2.1 Problem of disposal to the river

The river is not adequately managed in Albania. Rivers are reclaimed from both sides in many spots where they cross roads, which easily narrow the river width. Flood will surely occur unless the prompt and adequate control measures are taken. Especially, the prompt restoration measures have to be taken at the following two locations.

- Near the bridge where Lana River crosses Rruga Konferenca e Pezes.

Informal residences were recently demolished, but the scrap wood and bricks were disposed into the Lana River. As a result, the riverbed was raised and the river section became smaller. Furthermore, the Lana Interceptor discharges collected sewage near the bridge but its section has been half filled with the disposed scrap.

- Near the bridge where Tirana River crosses Klhesa e Kamzes

The soil is conveyed to the river from the banks and fills the river. The situations have become worse day by day and it is urgent to stop further reclamation. The sand filling not only makes the river width smaller but also causes soil accumulation at the downstream of the river, which will result in smaller margin of safety of the river.

2.2.2 Data collection

Above calculation are done in assumming some figures. It is nessisary to obtain the date of rainfall, flowrate of the river. Then the relation of the rainfall and flowrate of river will be annalized.

2.3 Attached Figure

- Design of the river (*Figure 2.3.1*)
- Survey point of the river (*Figure 2.3.2*)

2.4 Attached Table

- Water flow rate calculation table (*Table 2.4.1*)
- Q-H table for the planned river section (*Figure 2.4.1*)
- Q-H table for the existing river section (*Figure 2.4.2*)

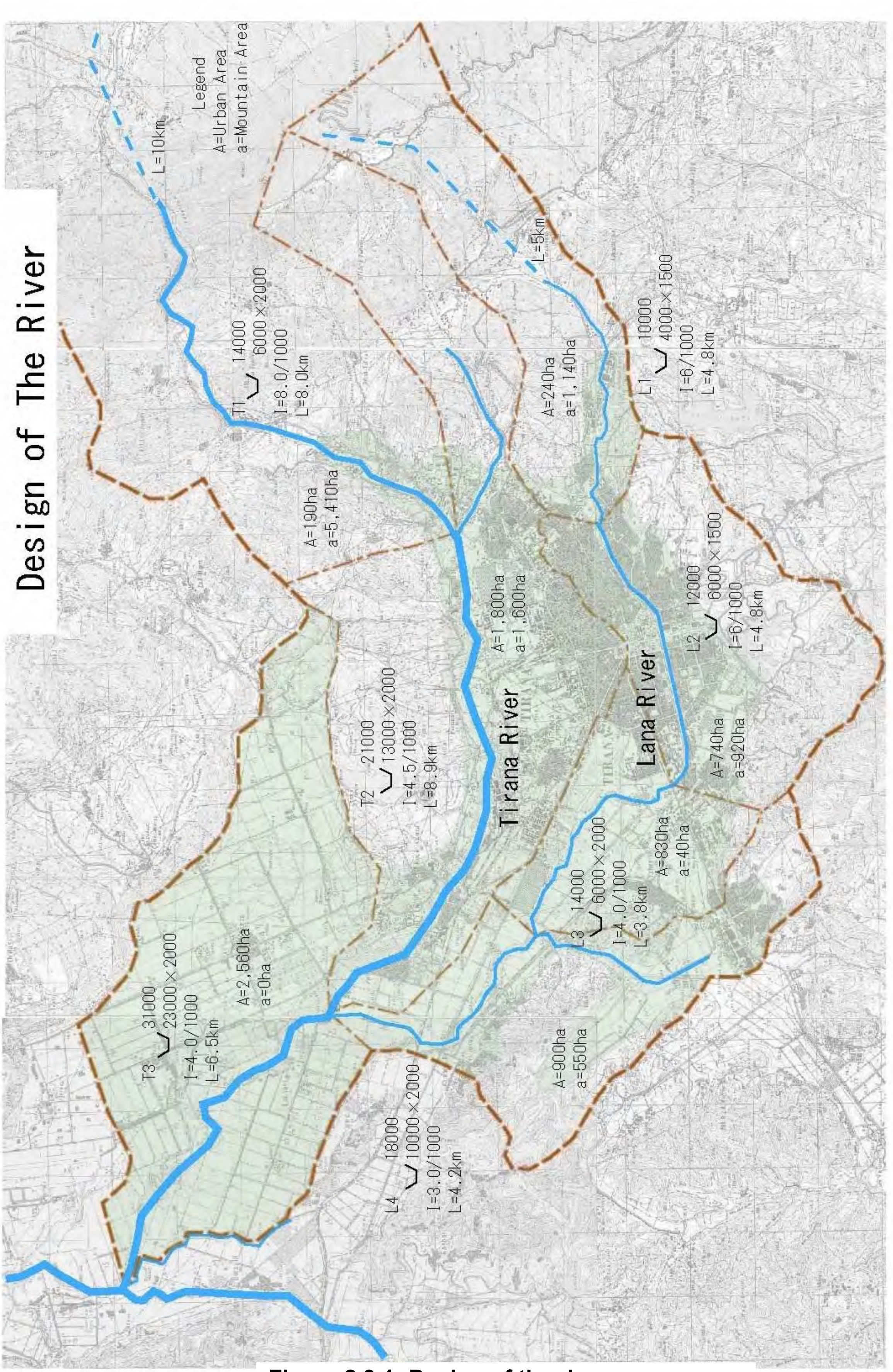


Figure 2.3.1 Design of the river

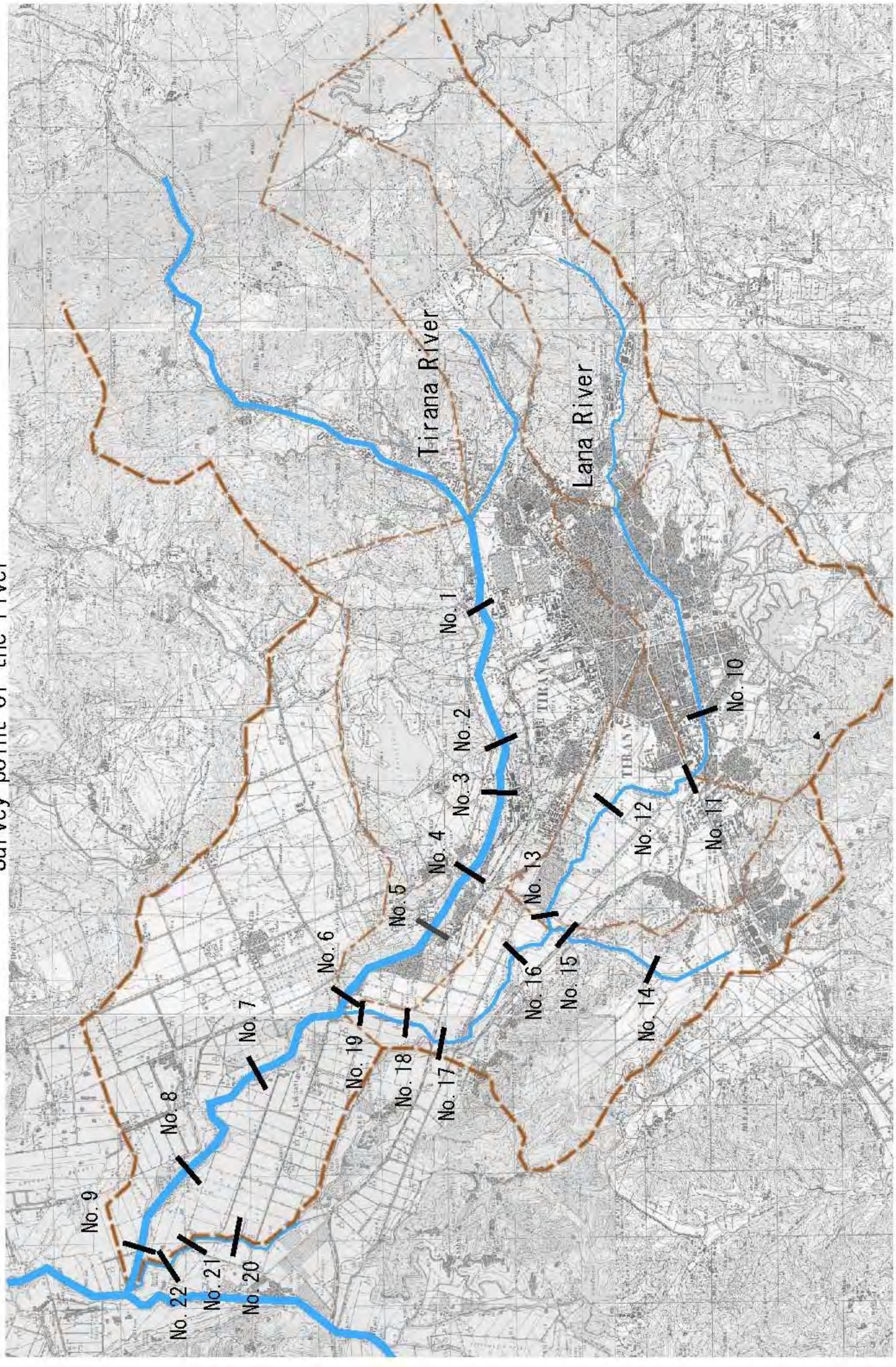


Figure 2.3.2 Survey point of the river

Table 2.4.1 Water flow rate calculation table

Return period=1 year

Water Flowrate Calculation Table

Depth Ratio: Circle 1.0, Square 1, n= 0.025

runn-off.co: City 0.50, Green 0.50

Rain fall formula: I=a/(t+b), a= 2240, b= 18, Return Period 1

No.		Area(ha)				Pipe Length		time			rain			Pipe shape	Sewer Pipe									Remarks
		City Area		Green Area										1 :circle 2 :square				Pipe Invert		Ground Level		Earth Cover		
Pipe	No of down	Incre.	Camul.	Incre.	Camul.	Incre.	Camul.	Velo	Incre.	Most.T	per ha Run-off	Quntity	Quntity in Pipe	Sewer Diameter	Slope	Velocity	Quantity	Begin	End	Begin	End	Begin	End	
		ha	ha	ha	ha	m	m	m/s	min	min					‰	m/s	m^3/s	m	m	m	m	m	m	
Lana River										109.3														h1 600
	L1					5,000	5,000			109.3														h2 200
L1	L2	240	240	1,140	1,140	4,800	9,800	3.1	25.8	135.1	0.0203	28.014	28.014	10000 2 □ 4000 × 1500	6.0	3.06	32.110							S 0.080
L2	L3	740	980	920	2,060	4,800	14,600	3.2	25.0	160.1	0.0175	53.200	53.200	12000 2 □ 6000 × 1500	6.0	3.23	43.548							Existing
L3	L4	830	1,810	40	2,100	3,800	18,400	3.1	20.4	180.5	0.0157	61.387	61.387	14000 2 □ 6000 × 2000	4.0	3.07	61.446							
L4	T3	900	2,710	550	2,650	4,200	22,600	2.8	25.0	205.5	0.0139	74.504	74.504	18000 2 □ 10000 × 2000	3.0	2.84	79.597							
Tinara River																								
										152.4														h1 1000
	T1					10,000	10,000			152.4														h2 230
T1	T2	190	190	5,410	5,410	8,000	18,000	4.3	31.0	183.4	0.0154	86.240	86.240	14000 2 □ 6000 × 2000	8.0	4.34	86.897							S 0.077
T2	T3	1,800	1,990	1,600	7,010	8,900	26,900	3.6	41.2	224.6	0.0128	115.200	115.200	21000 2 □ 13000 × 2000	4.5	3.59	122.157							
T3		2,560	7,260		9,660	6,500	33,400	3.6	30.1	254.7	0.0114	192.888	192.888	31000 2 □ 23000 × 2000	4.0	3.59	193.858							

Table 2.4.1 Water flow rate calculation table

Return period=30 years

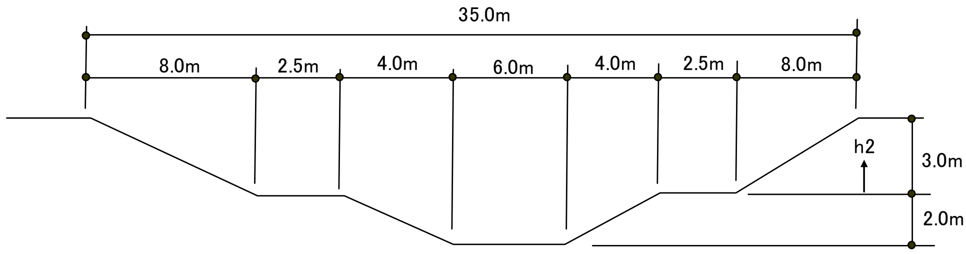
Water Flowrate Calculation Table

Depth Ratio: Circle 1.0, Square 1, n= 0.025

runn-off.co: City 0.50, Green 0.50 — Rain fall formula I=a/(t+b), a= 3600, b= 13, Return Period 30

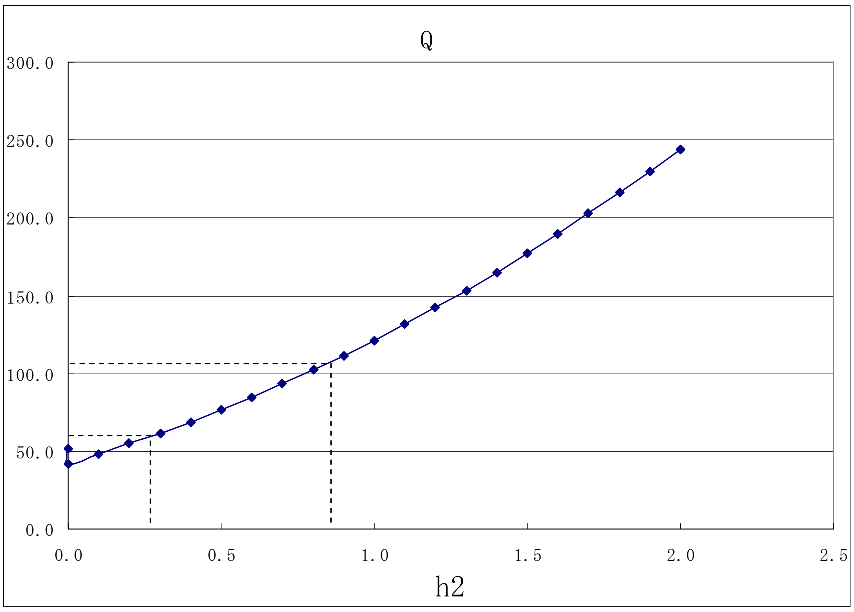
No. Pipe	No of down	City Area Incre. (ha)	City Area Camul. (ha)	Green Area Incre. (ha)	Green Area Camul. (ha)	Pipe Length Incre. (m)	Pipe Length Camul. (m)	Velo (m/s)	time Incre. (min)	time Most.T (min)	rain per ha Run-off	rain Quntity	Quntity in Pipe	Pipe shape 1 :circle 2 :square Sewer Diameter	Slope (‰)	Velocity (m/s)	Quantity (m^3/s)	Pipe Invert Begin (m)	Pipe Invert End (m)	Ground Level Begin (m)	Ground Level End (m)	Earth Cover Begin (m)	Earth Cover End (m)	Remarks
Lana River										109.3														h1 600
	L1					5,000	5,000			109.3														h2 200
L1	L2	240	240	1,140	1,140	4,800	9,800	3.7	21.5	130.8	0.0348	48.024	48.024											S 0.080
L2	L3	740	980	920	2,060	4,800	14,600	3.8	20.8	151.6	0.0304	92.416	92.416											Existing
L3	L4	830	1,810	40	2,100	3,800	18,400	3.7	17.0	168.6	0.0275	107.525	107.525											
L4	T3	900	2,710	550	2,650	4,200	22,600	3.4	20.8	189.4	0.0247	132.392	132.392											
Tinara River																								
	T1					10,000	10,000			152.4 152.4														h1 1000 h2 230
T1	T2	190	190	5,410	5,410	8,000	18,000	5.2	25.8	178.2	0.0261	146.160	146.160											S 0.077
T2	T3	1,800	1,990	1,600	7,010	8,900	26,900	4.3	34.3	212.5	0.0222	199.800	199.800											
T3		2,560	7,260		9,660	6,500	33,400	4.3	25.1	237.6	0.0199	336.708	336.708											

L3



h2-Q Relation n= 0.03 I= 4.0/1000

h2	A1	A2	Total A	S1	S2	Total S	R=A/S	$v=1/nR^{2/3}I^{1/2}$	Q=Av
0.0	20.00	0.00	20.00	14.94		14.94	1.338	2.5602	51.205
0.0	20.00	0.00	20.00	14.94	5.00	19.94	1.003	2.1121	42.242
0.1	20.00	1.93	21.93	14.94	5.57	20.51	1.069	2.2040	48.326
0.2	20.00	3.91	23.91	14.94	6.14	21.08	1.134	2.2926	54.809
0.3	20.00	5.94	25.94	14.94	6.70	21.65	1.198	2.3783	61.692
0.4	20.00	8.03	28.03	14.94	7.27	22.22	1.261	2.4613	68.979
0.5	20.00	10.17	30.17	14.94	7.84	22.78	1.324	2.5419	76.676
0.6	20.00	12.36	32.36	14.94	8.41	23.35	1.386	2.6202	84.784
0.7	20.00	14.60	34.60	14.94	8.98	23.92	1.447	2.6966	93.310
0.8	20.00	16.90	36.90	14.94	9.54	24.49	1.507	2.7710	102.257
0.9	20.00	19.25	39.25	14.94	10.11	25.06	1.567	2.8437	111.630
1.0	20.00	21.66	41.66	14.94	10.68	25.62	1.626	2.9149	121.434
1.1	20.00	24.12	44.12	14.94	11.25	26.19	1.684	2.9845	131.673
1.2	20.00	26.63	46.63	14.94	11.82	26.76	1.743	3.0528	142.352
1.3	20.00	29.20	49.20	14.94	12.38	27.33	1.800	3.1197	153.476
1.4	20.00	31.81	51.81	14.94	12.95	27.90	1.857	3.1855	165.051
1.5	20.00	34.49	54.49	14.94	13.52	28.46	1.914	3.2501	177.080
1.6	20.00	37.21	57.21	14.94	14.09	29.03	1.971	3.3136	189.570
1.7	20.00	39.99	59.99	14.94	14.66	29.60	2.027	3.3761	202.525
1.8	20.00	42.82	62.82	14.94	15.22	30.17	2.082	3.4377	215.950
1.9	20.00	45.70	65.70	14.94	15.79	30.74	2.138	3.4983	229.850
2.0	20.00	48.64	68.64	14.94	16.36	31.30	2.193	3.5582	244.231

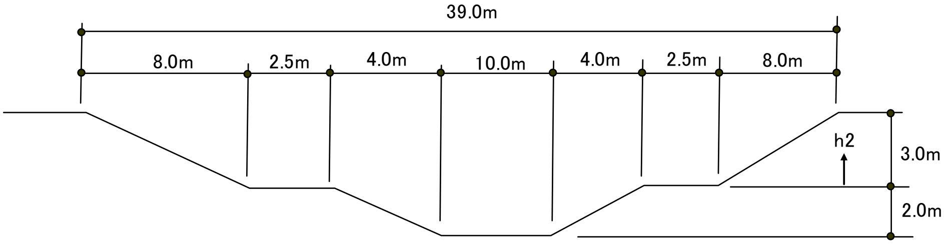


Q1=61.3m3/s
h2=0.3m

Q30=107.5m3/s
h2=0.9m

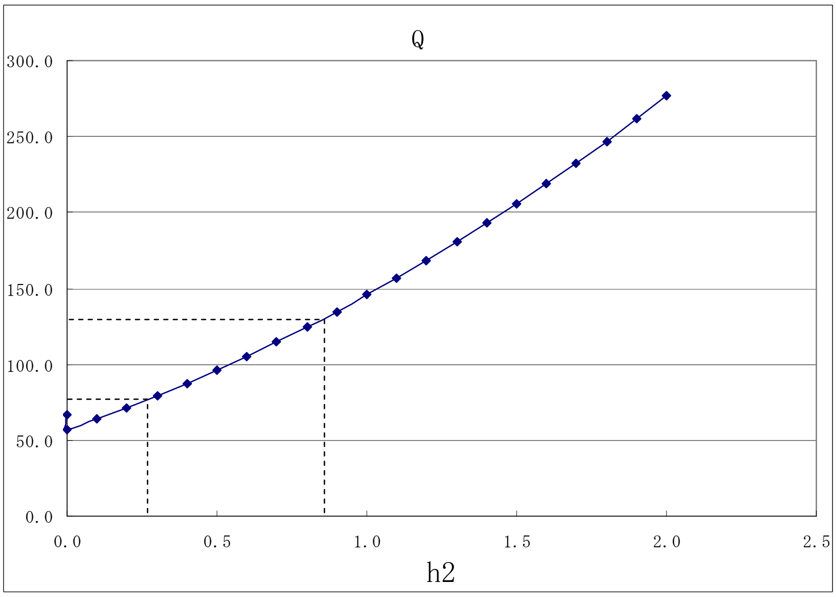
Figure 2.4.1 Q-H table for the planned river section

L4



h2-Q Relation   n= 0.03   I= 3.0/1000

h2	A1	A2	Total A	S1	S2	Total S	R=A/S	$v=1/nR^{2/3}I^{1/2}$	Q=Av
0.0	28.00	0.00	28.00	18.94		18.94	1.478	2.3690	66.331
0.0	28.00	0.00	28.00	18.94	5.00	23.94	1.169	2.0265	56.742
0.1	28.00	2.33	30.33	18.94	5.57	24.51	1.237	2.1041	63.810
0.2	28.00	4.71	32.71	18.94	6.14	25.08	1.304	2.1792	71.275
0.3	28.00	7.14	35.14	18.94	6.70	25.65	1.370	2.2521	79.139
0.4	28.00	9.63	37.63	18.94	7.27	26.22	1.435	2.3230	87.404
0.5	28.00	12.17	40.17	18.94	7.84	26.78	1.500	2.3919	96.072
0.6	28.00	14.76	42.76	18.94	8.41	27.35	1.563	2.4592	105.148
0.7	28.00	17.40	45.40	18.94	8.98	27.92	1.626	2.5248	114.632
0.8	28.00	20.10	48.10	18.94	9.54	28.49	1.688	2.5888	124.530
0.9	28.00	22.85	50.85	18.94	10.11	29.06	1.750	2.6515	134.843
1.0	28.00	25.66	53.66	18.94	10.68	29.62	1.811	2.7129	145.577
1.1	28.00	28.52	56.52	18.94	11.25	30.19	1.872	2.7731	156.733
1.2	28.00	31.43	59.43	18.94	11.82	30.76	1.932	2.8322	168.317
1.3	28.00	34.40	62.40	18.94	12.38	31.33	1.992	2.8901	180.330
1.4	28.00	37.41	65.41	18.94	12.95	31.90	2.051	2.9471	192.779
1.5	28.00	40.49	68.49	18.94	13.52	32.46	2.110	3.0031	205.665
1.6	28.00	43.61	71.61	18.94	14.09	33.03	2.168	3.0582	218.994
1.7	28.00	46.79	74.79	18.94	14.66	33.60	2.226	3.1124	232.769
1.8	28.00	50.02	78.02	18.94	15.22	34.17	2.283	3.1658	246.993
1.9	28.00	53.30	81.30	18.94	15.79	34.74	2.341	3.2185	261.672
2.0	28.00	56.64	84.64	18.94	16.36	35.30	2.397	3.2704	276.809

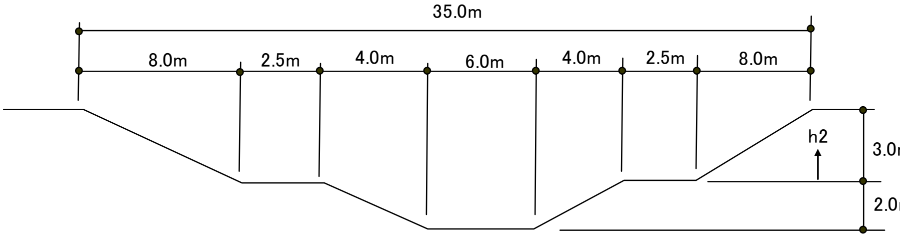


Q1=74.5m3/s
h2=0.3m

Q30=132.4m3/s
h2=0.9m

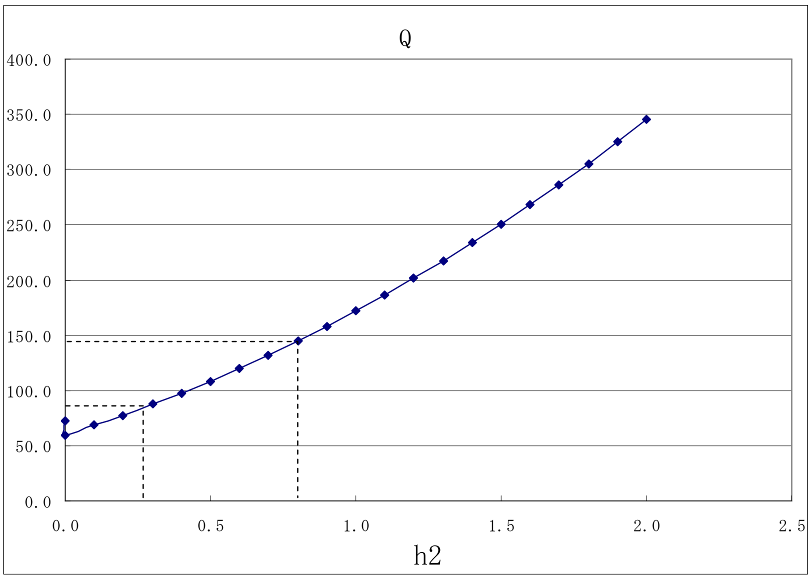
Figure 2.4.1 Q-H table for the planned river section

T1



h2-Q Relation   n= 0.03   I= 8.0/1000

h2	A1	A2	Total A	S1	S2	Total S	R=A/S	$v=1/nR^{2/3}I^{1/2}$	Q=Av
0.0	20.00	0.00	20.00	14.94		14.94	1.338	3.6207	72.414
0.0	20.00	0.00	20.00	14.94	5.00	19.94	1.003	2.9870	59.740
0.1	20.00	1.93	21.93	14.94	5.57	20.51	1.069	3.1169	68.344
0.2	20.00	3.91	23.91	14.94	6.14	21.08	1.134	3.2423	77.511
0.3	20.00	5.94	25.94	14.94	6.70	21.65	1.198	3.3634	87.245
0.4	20.00	8.03	28.03	14.94	7.27	22.22	1.261	3.4808	97.552
0.5	20.00	10.17	30.17	14.94	7.84	22.78	1.324	3.5948	108.436
0.6	20.00	12.36	32.36	14.94	8.41	23.35	1.386	3.7056	119.903
0.7	20.00	14.60	34.60	14.94	8.98	23.92	1.447	3.8135	131.961
0.8	20.00	16.90	36.90	14.94	9.54	24.49	1.507	3.9188	144.614
0.9	20.00	19.25	39.25	14.94	10.11	25.06	1.567	4.0217	157.869
1.0	20.00	21.66	41.66	14.94	10.68	25.62	1.626	4.1223	171.733
1.1	20.00	24.12	44.12	14.94	11.25	26.19	1.684	4.2207	186.213
1.2	20.00	26.63	46.63	14.94	11.82	26.76	1.743	4.3173	201.316
1.3	20.00	29.20	49.20	14.94	12.38	27.33	1.800	4.4120	217.048
1.4	20.00	31.81	51.81	14.94	12.95	27.90	1.857	4.5049	233.417
1.5	20.00	34.49	54.49	14.94	13.52	28.46	1.914	4.5963	250.429
1.6	20.00	37.21	57.21	14.94	14.09	29.03	1.971	4.6861	268.092
1.7	20.00	39.99	59.99	14.94	14.66	29.60	2.027	4.7746	286.413
1.8	20.00	42.82	62.82	14.94	15.22	30.17	2.082	4.8616	305.399
1.9	20.00	45.70	65.70	14.94	15.79	30.74	2.138	4.9474	325.058
2.0	20.00	48.64	68.64	14.94	16.36	31.30	2.193	5.0320	345.395

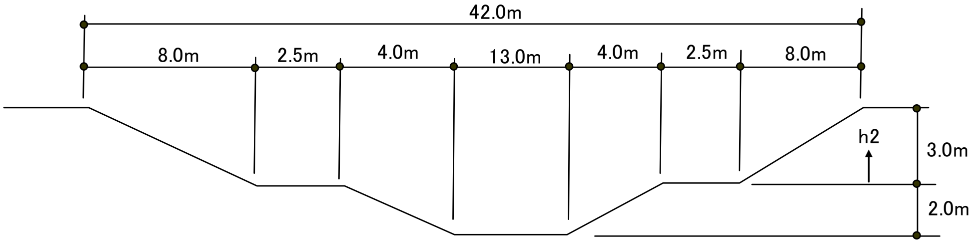


Q1=86.2m3/s
h2=0.3m

Q30=146.2m3/s
h2=0.8m

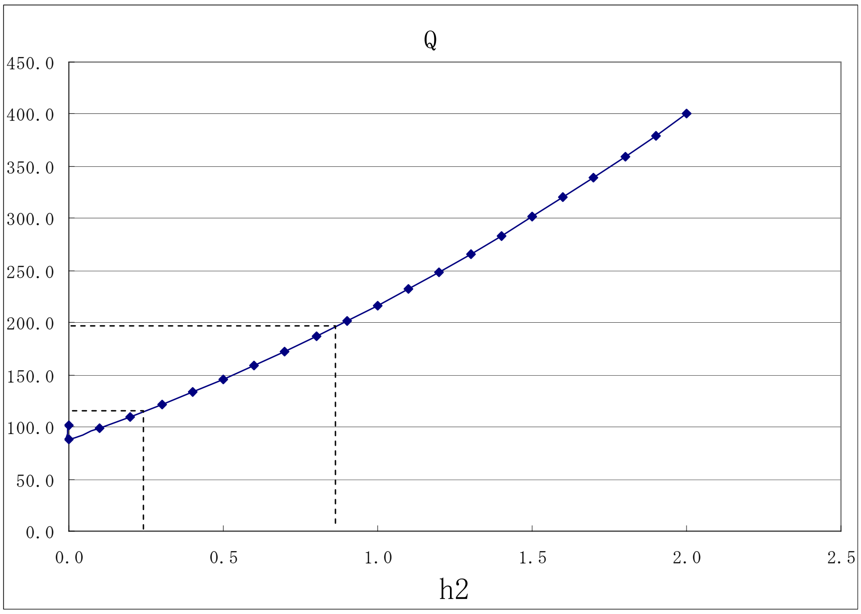
Figure 2.4.1 Q-H table for the planned river section

T2



h2-Q Relation n= 0.03 I= 4.5/1000

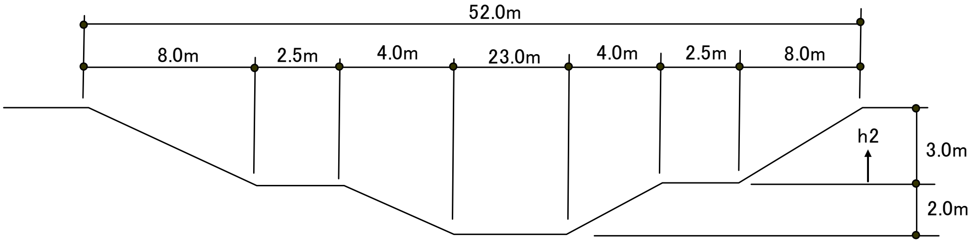
h2	A1	A2	Total A	S1	S2	Total S	R=A/S	$v=1/nR^{2/3}I^{1/2}$	Q=Av
0.0	34.00	0.00	34.00	21.94		21.94	1.549	2.9940	101.797
0.0	34.00	0.00	34.00	21.94	5.00	26.94	1.262	2.6111	88.778
0.1	34.00	2.63	36.63	21.94	5.57	27.51	1.331	2.7060	99.112
0.2	34.00	5.31	39.31	21.94	6.14	28.08	1.400	2.7981	109.982
0.3	34.00	8.04	42.04	21.94	6.70	28.65	1.467	2.8875	121.389
0.4	34.00	10.83	44.83	21.94	7.27	29.22	1.534	2.9745	133.335
0.5	34.00	13.67	47.67	21.94	7.84	29.78	1.600	3.0593	145.823
0.6	34.00	16.56	50.56	21.94	8.41	30.35	1.666	3.1421	158.855
0.7	34.00	19.50	53.50	21.94	8.98	30.92	1.730	3.2229	172.435
0.8	34.00	22.50	56.50	21.94	9.54	31.49	1.794	3.3019	186.565
0.9	34.00	25.55	59.55	21.94	10.11	32.06	1.858	3.3792	201.250
1.0	34.00	28.66	62.66	21.94	10.68	32.62	1.921	3.4550	216.492
1.1	34.00	31.82	65.82	21.94	11.25	33.19	1.983	3.5293	232.296
1.2	34.00	35.03	69.03	21.94	11.82	33.76	2.045	3.6023	248.665
1.3	34.00	38.30	72.30	21.94	12.38	34.33	2.106	3.6739	265.604
1.4	34.00	41.61	75.61	21.94	12.95	34.90	2.167	3.7443	283.117
1.5	34.00	44.99	78.99	21.94	13.52	35.46	2.227	3.8135	301.207
1.6	34.00	48.41	82.41	21.94	14.09	36.03	2.287	3.8816	319.880
1.7	34.00	51.89	85.89	21.94	14.66	36.60	2.347	3.9486	339.139
1.8	34.00	55.42	89.42	21.94	15.22	37.17	2.406	4.0147	358.989
1.9	34.00	59.00	93.00	21.94	15.79	37.74	2.465	4.0798	379.435
2.0	34.00	62.64	96.64	21.94	16.36	38.30	2.523	4.1440	400.481



Q1=115.2m3/s
h2=0.3m

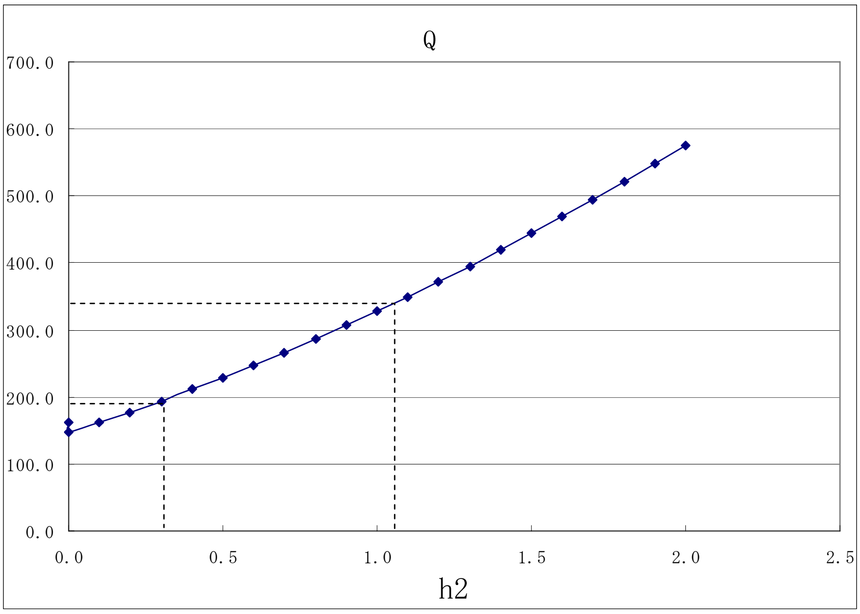
Q30=199.8m3/s
h2=0.9m

Figure 2.4.1 Q-H table for the planned river section



h2-Q Relation n= 0.03 I= 4.0/1000

h2	A1	A2	Total A	S1	S2	Total S	R=A/S	$v=1/nR^{2/3}I^{1/2}$	Q=Av
0.0	54.00	0.00	54.00	31.94		31.94	1.690	2.9916	161.548
0.0	54.00	0.00	54.00	31.94	5.00	36.94	1.462	2.7152	146.622
0.1	54.00	3.63	57.63	31.94	5.57	37.51	1.536	2.8068	161.745
0.2	54.00	7.31	61.31	31.94	6.14	38.08	1.610	2.8959	177.535
0.3	54.00	11.04	65.04	31.94	6.70	38.65	1.683	2.9827	193.992
0.4	54.00	14.83	68.83	31.94	7.27	39.22	1.755	3.0674	211.113
0.5	54.00	18.67	72.67	31.94	7.84	39.78	1.826	3.1501	228.899
0.6	54.00	22.56	76.56	31.94	8.41	40.35	1.897	3.2309	247.349
0.7	54.00	26.50	80.50	31.94	8.98	40.92	1.967	3.3100	266.465
0.8	54.00	30.50	84.50	31.94	9.54	41.49	2.037	3.3874	286.246
0.9	54.00	34.55	88.55	31.94	10.11	42.06	2.106	3.4633	306.695
1.0	54.00	38.66	92.66	31.94	10.68	42.62	2.174	3.5378	327.812
1.1	54.00	42.82	96.82	31.94	11.25	43.19	2.242	3.6109	349.598
1.2	54.00	47.03	101.03	31.94	11.82	43.76	2.309	3.6826	372.056
1.3	54.00	51.30	105.30	31.94	12.38	44.33	2.375	3.7531	395.188
1.4	54.00	55.61	109.61	31.94	12.95	44.90	2.441	3.8225	418.995
1.5	54.00	59.99	113.99	31.94	13.52	45.46	2.507	3.8907	443.480
1.6	54.00	64.41	118.41	31.94	14.09	46.03	2.572	3.9578	468.646
1.7	54.00	68.89	122.89	31.94	14.66	46.60	2.637	4.0240	494.495
1.8	54.00	73.42	127.42	31.94	15.22	47.17	2.701	4.0891	521.029
1.9	54.00	78.00	132.00	31.94	15.79	47.74	2.765	4.1533	548.252
2.0	54.00	82.64	136.64	31.94	16.36	48.30	2.829	4.2167	576.166



Q1=192.9m3/s
h2=0.3m

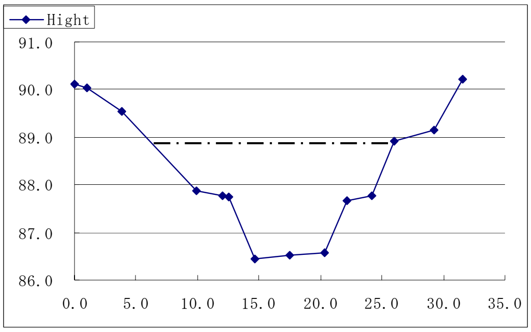
Q30=336.7m3/s
h2=1.1m

Figure 2.4.1 Q-H table for the planned river section

L2
Survay Point No=11
Q=92.4 m3/s

Lana River
No.11

Length	Camu.L	Hight	Depth
0.00	0.00	90.12	3.67
1.02	1.02	90.04	3.59
2.80	3.82	89.55	3.10
6.14	9.96	87.88	1.43
2.08	12.04	87.76	1.31
0.53	12.57	87.74	1.29
2.10	14.67	86.45	0.00
2.85	17.52	86.51	0.06
2.85	20.37	86.58	0.13
1.81	22.18	87.66	1.21
1.99	24.17	87.78	1.33
1.81	25.98	88.91	2.46
3.26	29.24	89.15	2.70
2.36	31.60	90.22	3.77



n= 0.03
I= 0.005
Q= 92.4 m3/s
h= 2.6 m3/s

h	Q	A	R	v
0.0	0.000	0.000	0.000	0.000
0.1	0.078	0.240	0.051	0.325
0.2	0.502	0.820	0.132	0.612
0.3	1.248	1.451	0.220	0.860
0.4	2.246	2.115	0.302	1.062
0.5	3.486	2.812	0.381	1.240
0.6	4.949	3.542	0.456	1.397
0.7	6.631	4.305	0.528	1.540
0.8	8.527	5.101	0.597	1.672
0.9	10.652	5.930	0.665	1.796
1.0	12.982	6.792	0.730	1.911
1.1	15.525	7.687	0.793	2.020
1.2	18.280	8.615	0.854	2.122
1.3	19.596	9.638	0.801	2.033
1.4	21.300	10.916	0.753	1.951
1.5	25.085	12.358	0.799	2.030
1.6	29.633	13.858	0.864	2.138
1.7	34.561	15.411	0.928	2.243
1.8	39.869	17.017	0.991	2.343
1.9	45.531	18.676	1.052	2.438
2.0	51.604	20.387	1.113	2.531
2.1	58.067	22.152	1.173	2.621
2.2	64.917	23.969	1.232	2.708
2.3	72.159	25.839	1.290	2.793
2.4	79.831	27.761	1.348	2.876
2.5	86.677	29.746	1.375	2.914
2.6	92.405	31.882	1.364	2.898
2.7	98.952	34.191	1.361	2.894
2.8	109.107	36.615	1.422	2.980
2.9	119.811	39.098	1.483	3.064
3.0	131.017	41.640	1.543	3.146
3.1	142.723	44.241	1.602	3.226
3.2	154.342	46.911	1.650	3.290
3.3	166.471	49.660	1.697	3.352
3.4	179.250	52.488	1.745	3.415
3.5	192.560	55.396	1.792	3.476
3.6	206.248	58.383	1.836	3.533
3.7	219.642	61.485	1.867	3.572
3.8	237.943	64.640	1.953	3.681
3.9	257.596	67.800	2.048	3.799
4.0	277.954	70.960	2.144	3.917
4.1	298.838	74.120	2.239	4.032
4.2	320.321	77.280	2.334	4.145
4.3	342.491	80.440	2.430	4.258
4.4	365.154	83.600	2.525	4.368

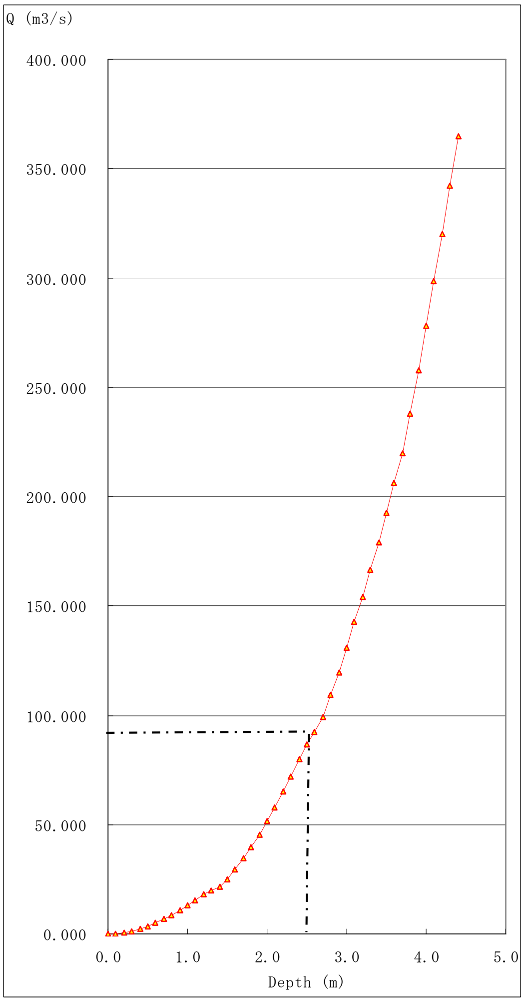
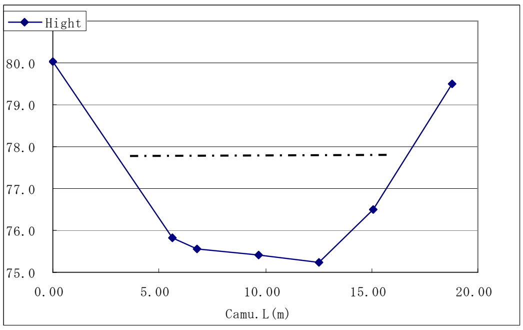


Figure 2.4.2 Q-H table for the existing river section

L3
Survay Point No=13
Q=107.5 m3/s

Lana River
No. 13

Length	Camu. L	Hight	Depth
0.00	0.00	80.04	4.80
5.62	5.62	75.82	0.58
1.16	6.78	75.56	0.32
2.88	9.66	75.40	0.16
2.88	12.54	75.24	0.00
2.53	15.07	76.49	1.25
3.72	18.79	79.49	4.25



n= 0.03
I= 0.005
Q= 107.5 m3/s
h= 3.0 m3/s

h	Q	A	R	v
0.000	0.000	0.000	0.000	0.000
0.100	0.032	0.100	0.049	0.316
0.200	0.202	0.400	0.099	0.505
0.300	0.595	0.901	0.148	0.660
0.400	1.345	1.559	0.221	0.862
0.500	2.393	2.284	0.296	1.048
0.600	3.722	3.073	0.368	1.211
0.700	5.385	3.906	0.447	1.379
0.800	7.304	4.772	0.523	1.531
0.900	9.471	5.672	0.596	1.670
1.000	11.878	6.606	0.666	1.798
1.100	14.540	7.573	0.735	1.920
1.200	17.433	8.574	0.801	2.033
1.300	20.622	9.607	0.869	2.147
1.400	24.076	10.667	0.937	2.257
1.500	27.773	11.752	1.004	2.363
1.600	31.699	12.864	1.069	2.464
1.700	35.862	14.001	1.133	2.561
1.800	40.244	15.164	1.195	2.654
1.900	44.884	16.352	1.257	2.745
2.000	49.740	17.567	1.317	2.831
2.100	54.828	18.807	1.376	2.915
2.200	60.175	20.072	1.435	2.998
2.300	65.732	21.364	1.492	3.077
2.400	71.548	22.681	1.549	3.155
2.500	77.599	24.024	1.605	3.230
2.600	83.879	25.392	1.660	3.303
2.700	90.426	26.786	1.715	3.376
2.800	97.206	28.206	1.769	3.446
2.900	104.218	29.652	1.822	3.515
3.000	111.501	31.124	1.875	3.582
3.100	119.054	32.621	1.928	3.650
3.200	126.798	34.144	1.979	3.714
3.300	134.856	35.692	2.031	3.778
3.400	143.148	37.266	2.082	3.841
3.500	151.672	38.866	2.132	3.902
3.600	160.525	40.492	2.183	3.964
3.700	169.563	42.144	2.232	4.023
3.800	178.930	43.821	2.282	4.083
3.900	188.533	45.524	2.331	4.141
4.000	198.419	47.252	2.380	4.199
4.100	208.544	49.007	2.428	4.255
4.200	218.955	50.787	2.476	4.311
4.300	230.256	52.591	2.534	4.378

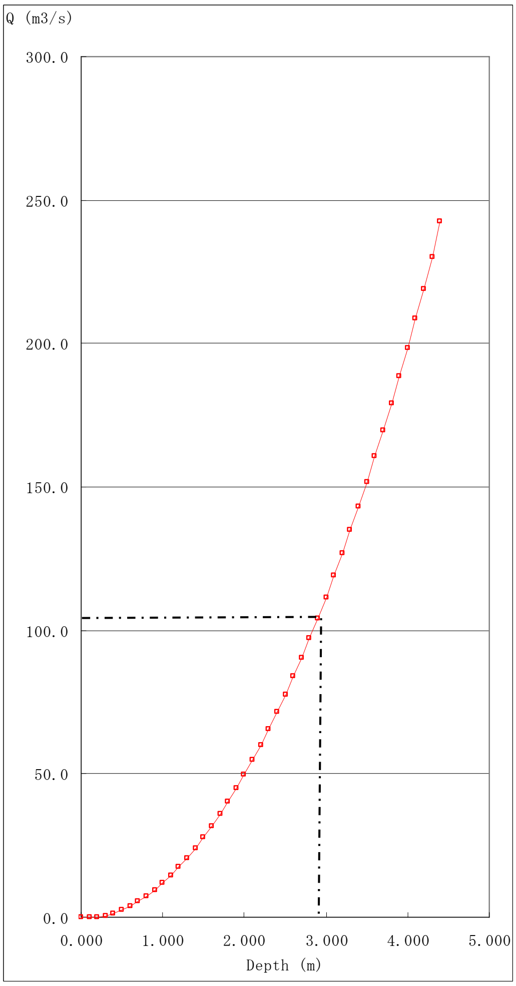
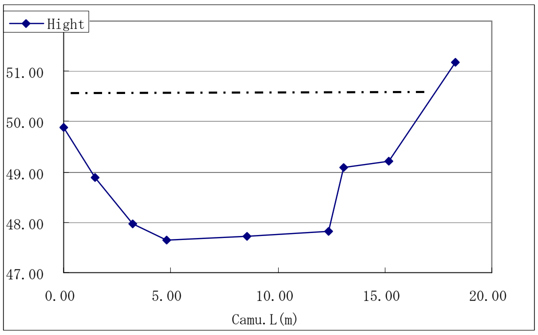


Figure 2.4.2 Q-H table for the existing river section

L4
Survay Point No=19
Q=132.4 m3/s

Lana River
No. 19

Length	Camu. L	Hight	Depth
0. 00	0. 00	49. 88	2. 24
1. 48	1. 48	48. 89	1. 25
1. 73	3. 21	47. 97	0. 33
1. 62	4. 83	47. 64	0. 00
3. 76	8. 59	47. 73	0. 09
3. 76	12. 35	47. 82	0. 18
0. 75	13. 10	49. 09	1. 45
2. 08	15. 18	49. 21	1. 57
3. 11	18. 29	51. 19	3. 55



n= 0. 03
I= 0. 004
Q= 132. 4 m3/s
h= 3. 1 m3/s

h	Q	A	R	v
0. 000	0. 000	0. 000	0. 000	0. 000
0. 100	0. 067	0. 233	0. 050	0. 287
0. 200	0. 443	0. 925	0. 108	0. 479
0. 300	1. 289	1. 804	0. 197	0. 715
0. 400	2. 495	2. 731	0. 285	0. 914
0. 500	4. 019	3. 683	0. 372	1. 091
0. 600	5. 816	4. 661	0. 455	1. 248
0. 700	7. 880	5. 662	0. 536	1. 392
0. 800	10. 190	6. 689	0. 614	1. 523
0. 900	12. 745	7. 740	0. 690	1. 647
1. 000	15. 524	8. 817	0. 763	1. 761
1. 100	18. 541	9. 917	0. 835	1. 870
1. 200	21. 767	11. 043	0. 904	1. 971
1. 300	25. 239	12. 192	0. 973	2. 070
1. 400	28. 956	13. 364	1. 042	2. 167
1. 500	31. 683	14. 576	1. 047	2. 174
1. 600	34. 447	15. 949	1. 037	2. 160
1. 700	39. 187	17. 392	1. 105	2. 253
1. 800	44. 180	18. 865	1. 171	2. 342
1. 900	49. 447	20. 368	1. 236	2. 428
2. 000	54. 992	21. 903	1. 300	2. 511
2. 100	60. 837	23. 468	1. 364	2. 592
2. 200	66. 925	25. 063	1. 426	2. 670
2. 300	73. 572	26. 687	1. 496	2. 757
2. 400	80. 716	28. 328	1. 572	2. 849
2. 500	88. 128	29. 984	1. 647	2. 939
2. 600	95. 806	31. 656	1. 721	3. 026
2. 700	103. 782	33. 343	1. 795	3. 113
2. 800	112. 020	35. 047	1. 868	3. 196
2. 900	120. 512	36. 766	1. 940	3. 278
3. 000	129. 300	38. 501	2. 012	3. 358
3. 100	138. 335	40. 251	2. 083	3. 437
3. 200	147. 664	42. 017	2. 154	3. 514
3. 300	157. 241	43. 799	2. 224	3. 590
3. 400	167. 061	45. 597	2. 293	3. 664
3. 500	177. 217	47. 410	2. 363	3. 738
3. 600	188. 122	49. 237	2. 442	3. 821
3. 700	199. 922	51. 066	2. 533	3. 915
3. 800	212. 009	52. 895	2. 624	4. 008
3. 900	224. 321	54. 724	2. 714	4. 099
4. 000	236. 967	56. 553	2. 805	4. 190
4. 100	249. 888	58. 382	2. 896	4. 280
4. 200	263. 082	60. 211	2. 987	4. 369
4. 300	276. 486	62. 040	3. 077	4. 457
4. 400	290. 216	63. 869	3. 168	4. 544

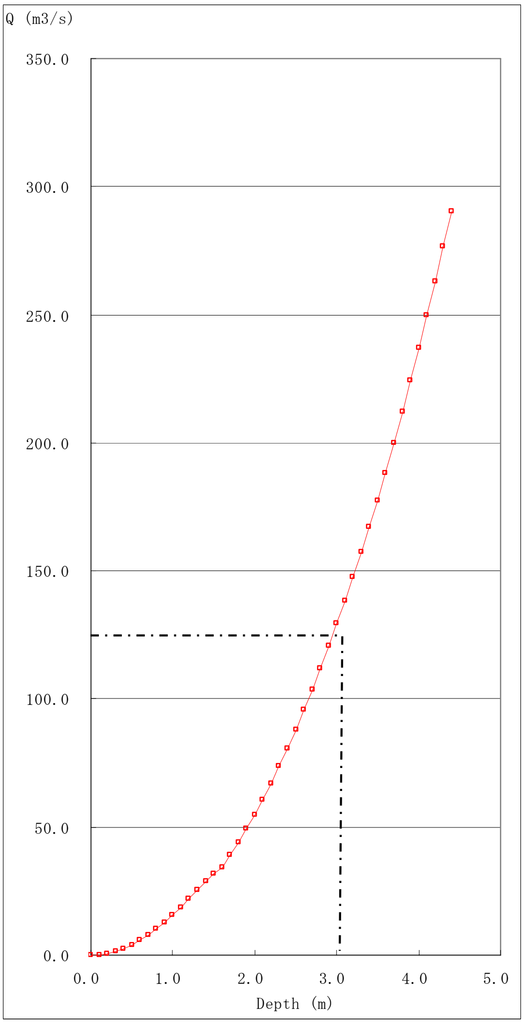
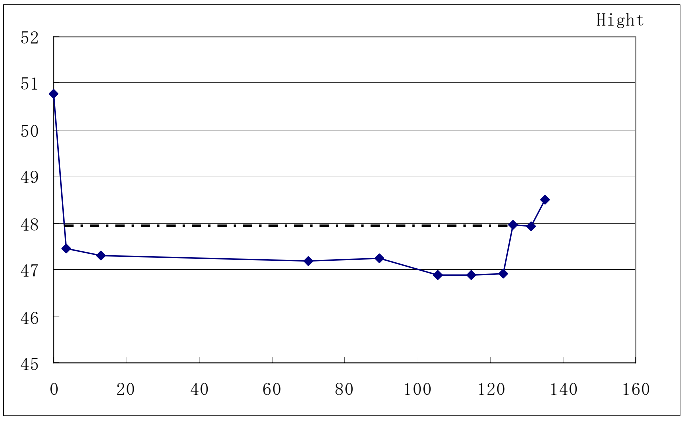


Figure 2.4.2 Q-H table for the existing river section

T2
Survay Point No=6
Q=199.8 m3/s

Tirana River
No. 6

Length	Camu. L	Hight	Depth
0	0	50.76	3.89
3.47	3.47	47.45	0.58
9.42	12.89	47.29	0.42
57.17	70.06	47.18	0.31
19.37	89.43	47.25	0.38
16.34	105.77	46.87	0.00
8.88	114.65	46.89	0.02
8.88	123.53	46.92	0.05
2.96	126.49	47.96	1.09
4.92	131.41	47.94	1.07
3.63	135.04	48.51	1.64



n= 0.03
I= 0.007
Q= 199.8 m3/s
h= 1.1 m3/s

h	Q	A	R	v
0	0	0	0	0
0.1	0.771	1.595	0.072	0.484
0.2	3.202	4.044	0.151	0.792
0.3	7.094	6.952	0.221	1.020
0.4	9.809	13.480	0.133	0.728
0.5	24.560	24.743	0.212	0.993
0.6	46.010	36.703	0.301	1.254
0.7	74.062	48.887	0.400	1.515
0.8	107.126	61.110	0.498	1.753
0.9	144.968	73.372	0.596	1.976
1.0	187.154	85.673	0.693	2.185
1.1	227.919	98.114	0.760	2.323
1.2	278.942	111.019	0.855	2.513
1.3	333.963	123.997	0.949	2.693
1.4	393.086	137.051	1.043	2.868
1.5	455.949	150.178	1.136	3.036
1.6	522.432	163.379	1.228	3.198
1.7	593.884	176.643	1.324	3.362
1.8	669.632	189.923	1.422	3.526
1.9	749.009	203.213	1.520	3.686
2.0	831.943	216.514	1.618	3.842
2.1	918.005	229.825	1.715	3.994
2.2	1007.831	243.146	1.813	4.145
2.3	1100.642	256.478	1.910	4.291
2.4	1196.741	269.821	2.007	4.435
2.5	1296.073	283.174	2.104	4.577
2.6	1398.594	296.537	2.201	4.716
2.7	1504.263	309.911	2.298	4.854
2.8	1613.042	323.296	2.395	4.989
2.9	1724.424	336.691	2.491	5.122
3.0	1838.812	350.096	2.587	5.252

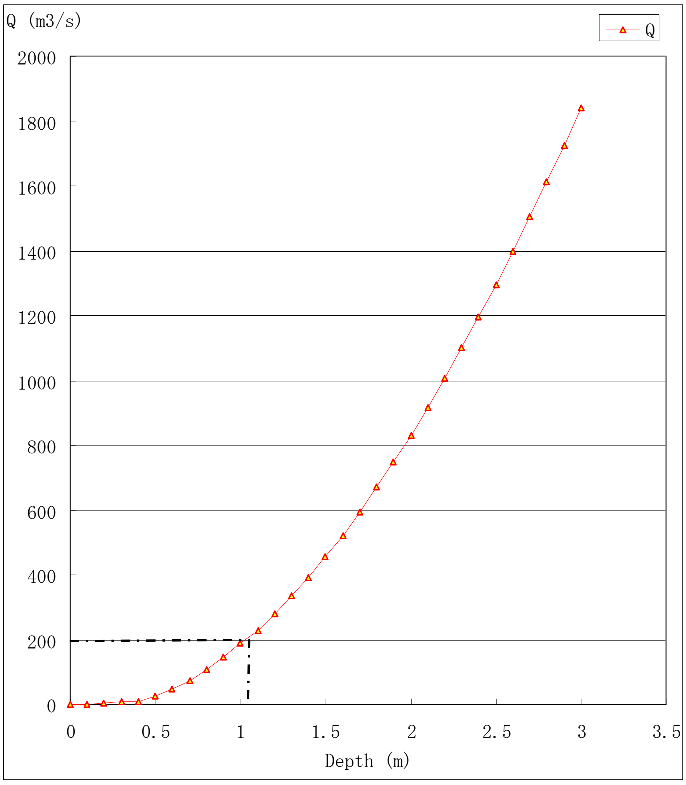
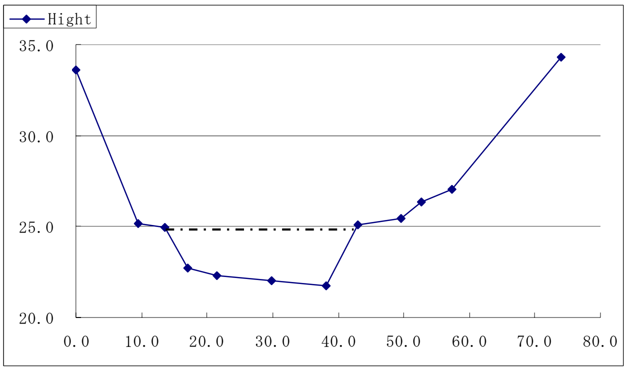


Figure 2.4.2 Q-H table for the existing river section

T3
Survay Point No=9
Q=336.7 m3/s

Tirana River
No.9

Length	Camu.L	Hight	Depth
0.00	0.00	33.63	11.92
9.45	9.45	25.17	3.46
4.15	13.60	24.96	3.25
3.36	16.96	22.73	1.02
4.57	21.53	22.32	0.61
8.33	29.86	22.01	0.30
8.34	38.20	21.71	0.00
4.87	43.07	25.09	3.38
6.43	49.50	25.41	3.70
3.14	52.64	26.37	4.66
4.61	57.25	27.02	5.31
16.76	74.01	34.29	12.58



n= 0.03
I= 0.007
Q= 336.7 m3/s
h= 3.2 m3/s

h	Q	A	R	v
0.0	0	0	0	0
0.1	0.055	0.146	0.049	0.374
0.2	0.350	0.585	0.099	0.598
0.3	1.028	1.316	0.148	0.781
0.4	2.222	2.335	0.199	0.952
0.5	4.018	3.637	0.249	1.105
0.6	6.517	5.222	0.299	1.248
0.7	10.124	7.026	0.371	1.441
0.8	14.524	8.957	0.443	1.622
0.9	19.667	11.014	0.512	1.786
1.0	25.577	13.197	0.579	1.938
1.1	32.824	15.475	0.663	2.121
1.2	40.949	17.784	0.750	2.303
1.3	49.849	20.123	0.837	2.477
1.4	59.379	22.491	0.921	2.640
1.5	69.643	24.889	1.005	2.798
1.6	80.533	27.316	1.087	2.948
1.7	92.080	29.773	1.168	3.093
1.8	104.325	32.259	1.249	3.234
1.9	117.147	34.774	1.328	3.369
2.0	130.592	37.319	1.406	3.499
2.1	144.649	39.894	1.483	3.626
2.2	159.306	42.498	1.559	3.749
2.3	174.557	45.132	1.634	3.868
2.4	190.466	47.795	1.709	3.985
2.5	206.877	50.487	1.782	4.098
2.6	223.939	53.209	1.855	4.209
2.7	241.566	55.960	1.927	4.317
2.8	259.756	58.741	1.998	4.422
2.9	278.591	61.552	2.069	4.526
3.0	297.882	64.392	2.138	4.626
3.1	317.903	67.261	2.208	4.726
3.2	338.372	70.160	2.276	4.823
3.3	352.913	73.111	2.279	4.827
3.4	359.977	76.255	2.204	4.721
3.5	365.119	79.723	2.106	4.580
3.6	379.582	83.436	2.085	4.549
3.7	395.664	87.362	2.071	4.529
3.8	423.424	91.416	2.142	4.632
3.9	452.114	95.513	2.213	4.734
4.0	481.606	99.655	2.283	4.833

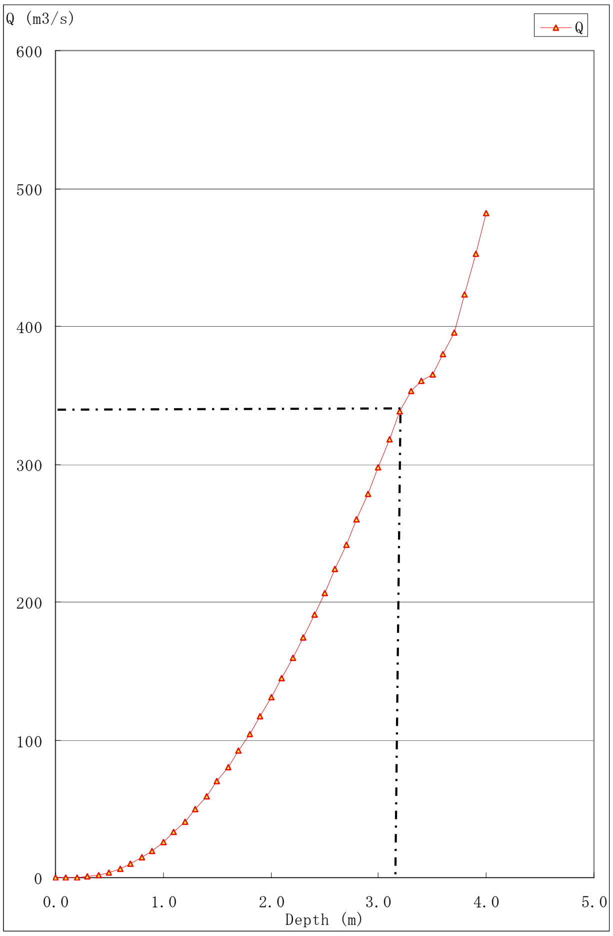


Figure 2.4.2 Q-H table for the existing river section

Appendix 3

Water Quality

Appendix 3 Water Quality

3.1 Technical Specifications

3.1.1 Purpose

The work called for water quality survey (hereinafter referred to as the Work) will be conducted as a part of on the Development Plan of Sewerage system and Sewage Treatment Plant for the Greater Tirana in the Republic of Albania. The Work results will be used by the JICA Study Team (hereinafter referred to as the Client) to understand the present water quality of Rivers and sewage and pollution level in the Rivers and to preparation a design of influent quality to a sewage treatment plant proposed in the Sewerage Master Plan and a Feasibility Study of the Priority projects identified in the Master Plan.

3.1.2 General Requirements

Water samples shall be taken at sites as specified, water quality analysis on the parameters specified for each sample shall be conducted at the contractor's laboratory or at the laboratory approved by the Client, and submit Reports on the result of the analysis. When some water quality parameters will not be analyzed at the contractor's laboratory, the Contractor shall propose an appropriate laboratory in his technical proposal for the Work.

The followings are general requirements in undertaking the Work.

(1) Analysis methods shall be according to "Standard Method for the Examination of Water and Wastewater, 19th or 20th Edition, APHA, AWWA, WEF." Analysis method other than this may be allowed as the Study Team judged adequate and acceptable.
(2) Water quality analysis shall be carried out with the precision as specified in the above methods.
(3) The Contractor shall assign a specialist familiar with water quality survey and the sampling and analysis shall be conducted under supervision of the specialist.
(4) The Contractor shall assign sufficient number of personnel in order to carry out sampling smoothly.
(5) All necessary work and equipment for sampling including car arrangements, staff assignment, sampling bottles shall be provided by the Contractor.
(6) All necessary work and equipment for water quality analysis and reporting of its result shall be provided by the Contractor.

3.1.3 Scope of Work

(1) Sampling

At 10 different locations, total 20 water samples shall be taken at two different events: one water sample each at fine weather condition and one water sample each at wet weather condition. The sampling details and locations are shown in *Table 3.1.1* and *Figure 3.1.1*, respectively.

The exact sampling locations shall be as designated by the Client.

Samples shall be preserved around 4 Celsius after taken.

When the samples are taken, some photos shall be taken, and the site conditions, weather and other field observations shall be recorded by the Contractor.

(2) Measurements at the sites

When samples are taken, the following parameters shall be measured and recorded at the site immediately samples are taken:

- Weather, date and time, and ambient temperature
- Water temperature and pH of each sample

Table 3.1.1 Sampling Locations and Sample Numbers

SAMPLING LOCATION			SAMPLE NUMBER
1. Six (8) locations along the river			
Upper stream, confluent, and downstream of the outfalls to the rivers	R1	One (1) location at the upstream area of Lana River (same location as the 1st sampling point of Lana River monitored by the Institute of Environment)	2 (1 locations x 1 sample x 2 events)
	R2	One (1) location at the upstream of the sewage inflowing point in Lana River (near Shyqyri Ishimi Street along Lana River)	2 (1 locations x 1 sample x 2 events)
	R3	One (1) location at the upstream of Tirana River (same location as the 1st sampling point of Tirana River monitored by the Institute of Environment)	2 (1 locations x 1 sample x 2 events)
	R4	One (1) location in Tirana River, at the upstream of the confluence point of Lana River and Tirana River	2 (1 locations x 1 sample x 2 events)
	R5	One (1) location in Lana River, at the upstream of the confluence point of Lana River and Tirana River	2 (1 locations x 1 sample x 2 events)
	R6	One (1) location at the downstream of the proposed sewage treatment plant	2 (1 locations x 1 sample x 2 events)
Upstream and downstream of discharging from major industrial area	F1	One (1) point at the upstream of the discharge from industry area in Lana River (Same location as the 2nd sampling point of Lana River monitored by the Institute of Environment)	2 (1 locations x 1 sample x 2 events)
	F2	One (1) point at the downstream of the discharge from industry area in Lana River (Near the crossing of railway and Lana River, just after the discharging point of Stera Beer Factory)	2 (1 locations x 1 sample x 2 events)
Sub-Total		8 locations	**16 samples**
2. Two locations in the existing combined sewers			
Influent wastewater quality to propose sewage treatment plant	S1	One (1) location at the sewage discharging point (near Shyqyri Ishimi Street along Lana River)	2 (1 locations x 1 sample x 2 events)
	S2	One (1) location at the sewage discharging point of Tirana Interceptor	2 (1 locations x 1 sample x 2 events)
Sub-Total		2 locations	**4 samples**
3. Total		10 locations	**20 samples**

(3) Water Quality Analysis

Samples shall be analyzed on parameters instructed by the following table except pH and water temperature as specified above.

Table 3.1.2 Water Quality Parameters and Sample Number

No.	Parameter	Sample Number at one event			Total
		River	Sewer	Sub Total	
1	pH	8	2	10	20
2	Water Temp, ℃	8	2	10	20
3	Color	8	2	10	20
4	BOD_5, mg/L	8	2	10	20
5	COD, mg/L	8	2	10	20
6	NH_4^+-N, mg/L	8	2	10	20
7	T-N, mg/L	8	2	10	20
8	T-P, mg/L	8	2	10	20
9	Total Residuals, mg/L	8	2	10	20
10	Total Coliform, MPN/100mL	8	2	10	20
11	Fecal Coliform, MPN/100mL	8	2	10	20
	Total	88	22	110	220

3.1.4 Submittal

Upon the completion of water quality analysis, analysis results shall be submitted to the Client within two weeks from the date of second sampling.

A report shall be prepared and submitted in English (A4 size) to the Client within three weeks after the second sampling which shall contain the followings:

- A description of the work carried out, including sampling location map, sampling date and time, and records of observations and findings during sampling events
- Analytical methods, and equipment used if any special equipment
- Results of analysis
- An interpretation of analytical results with reference to the water quality standards/guidelines used in Albania applicable to rivers and discharges from industries.

The report shall be comprised with three (3) sets each of hard copies, including one set of copy of electronic files with compact disks (CD) saving the contents of the report. The application software shall be mutually agreed.

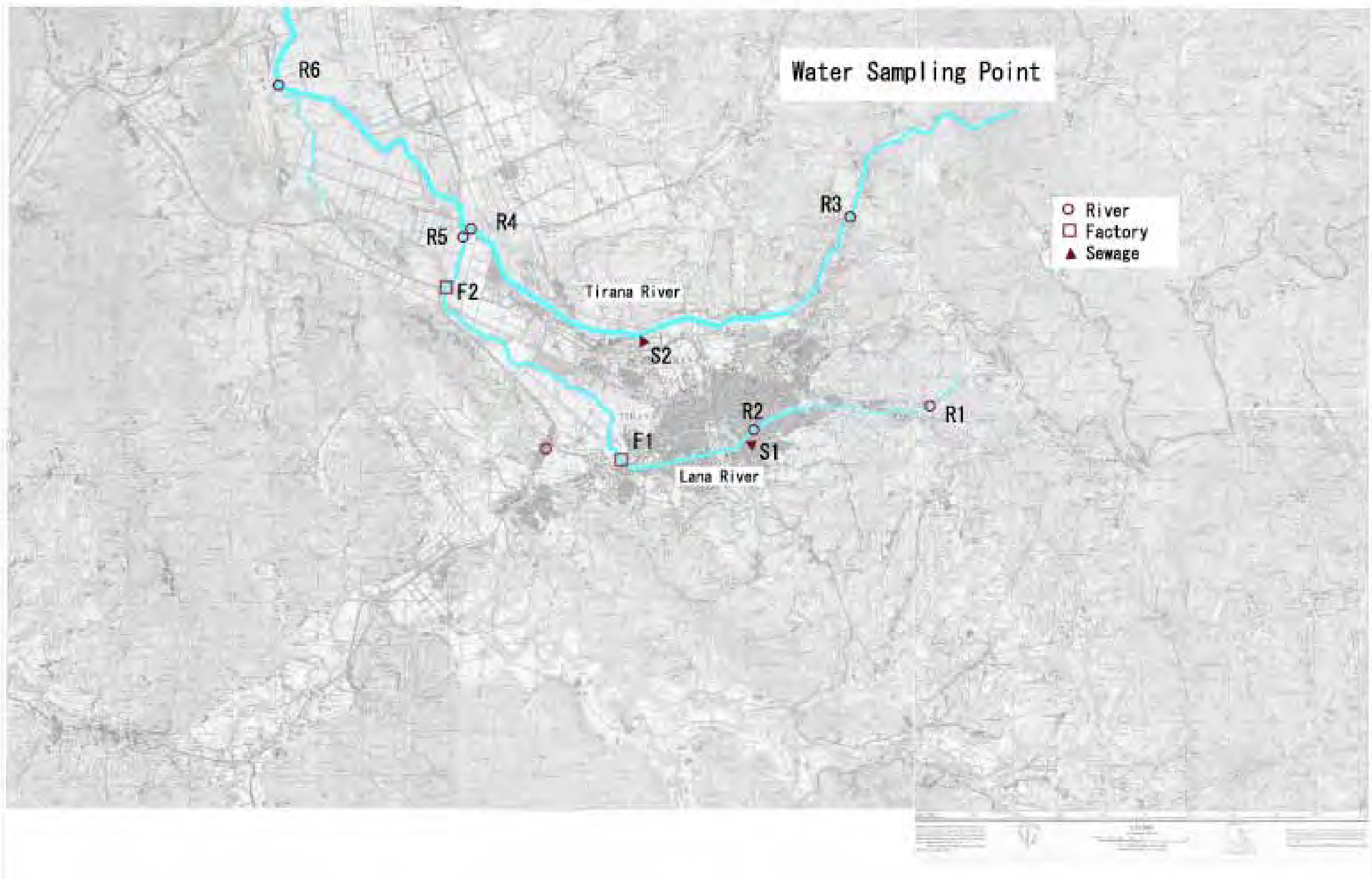


Figure 3.1.1 Sampling Locations