CHAPTER 10 PRELIMINARY COST ESTIMATES AND IMPLEMENTATION PLAN

10.1 Condition of the Cost Estimates

10.1.1 Composition of Project Cost

The Project financial cost comprises the following cost items.

- Construction Cost
- Land Acquisition (and Compensation) Cost
- Engineering Services Cost
- Government's Administration Cost
- Organizational Development Cost
- Physical Contingency
- Price Contingency

10.1.2 Conditions and Assumptions for Cost Estimate

(1) Price Level

The price level at the time of site investigation for the project cost estimate is Nonember 2007.

(2) Foreign Exchange

The cost estimate is made on the price level as of the Nov 2007, since the cost data for the cost estimate are collected in this period. The foreign exchange rate is shown below.

2007	Jun7	Jul	Aug	Sep	Oct	Nov	Average
SP / Euro	71.583	72.020	72.117	71.599	74.335	75.291	**72.82**

(3) Project Period

An Implementation period is from 2008 to 2025.

10.1.3 Estimation Approach

(1) Construction Cost

The construction cost is estimated by the following approach.

Sewage Treatment Plant (STP)

The construction costs for STPs are estimated by cost function basis. The cost functions are presented in the Appendix 10.1. The proposed cost functions were adopted referring to the Japanese ones which reflect incoming wastewater amount.

The cost function was corrected by using data which were collected, examined and analyzed during the site investigation. The cost function includes 1) Civil works, 2) Mechanical and

Electrical works and 3) Overhead etc.

Pumping Station (PS)

All the pumping station planned in this project are small-scale pumping stations.

About the small-scale PSs, the construction costs per place were set up supposing Manhole type Pumping station use.

Pipes

The installation cost for pipes is estimated by unit cost basis per meter. The unit cost is decided by past construction cost.

(2) Land Acquisition (and Compensation) Cost

Land Acquisition Costs are based on market price in the area of the construction site.

(3) Engineering Services Cost

The engineering services expenses are estimated in proportion to the construction cost to cover the tender design and construction supervision. Ten (10) percent of the construction cost is applied.

(4) Government's Administration Cost

The Government's administration expenses for project implementation are added to the construction cost. This cost is for the proper project management to execute the project implementation smoothly. Five (5) percent of the construction cost is applied.

(5) Organizational Development Cost

The Organizational development cost is for improving the organization to perform proper management after construction of facilities, such as establishment of Sewerage Company. Three (3) percent of the construction cost is applied.

(6) Physical Contingency

The Physical contingency is provided to cover minor differences in actual and estimated quantities, omissions of minor items of work incidental to pay items, difficulties unforeseeable at the site, possible changes in plans, and other uncertainties. Ten (10) percent of the construction cost is applied.

(7) Price Contingency

The Price contingency is calculated from the sum of the construction, administration and engineering cost multiplying annual inflation rate seven point two (7.2) percent (quoted from IMF 2005)[1].

[1] The IMF forecast inflation rate is also confirmed by the official historical statistical data. Thus, the General Price Index in Syria increased by approximately 8% in 2005 and by 5% in 2004 (See Statistical Abstract 2006 issued by the Central Bureau of Statistics, p.365).

About the applied rate of each item, it is set up based on the track record and experience of the sewerage project in other countries.

10.2 Cost Estimates Related to the Projects

A summary of the cost estimate for each project is shown below. The details of cost estimates are shown in Supporting Report (Price Contingency is calculated in **Table 10.3.1 ~ Table 10.3.7**).

(1) Lattakia (Slunfeh)

Project components

STP: 3 places (Q=610 m^3/day per place, Total Q=1,830 m^3/day)
(Submerged Attached Growth Method)

PS: 2 places (Q=0.5 m^3/min)

Pipes: Dia. 250mm 7,900 m
Dia. 100mm 1,000 m

Table 10.2.1 Project Cost for Slunfeh

Cost Item	Cost (10^3SP)
Construction Cost	
1) STP	84,504
2) PS	25,700
3) Pipes	1,340
Total of Construction Cost	**111,544**
Land Acquisition Cost	1,000
Engineering Cost	11,154
Government's Administration Cost	5,577
Organizational Development Cost	3,347
Physical Contingency	11,154
Sub Total	**32,232**
Price Contingency	33,651
Total (Excluding Price Contingency)	**143,776**
Total	**177,427**

(2) Tartous (Banias)

Project components

STP: Q=19,560 m^3/day (Oxidation Ditch Method), 1 place

PS: 8 places (Q=3.0 m^3/min)
10 places (Q=1.0 m^3/min)

Pipes: Dia. 600mm 4,620 m
Dia. 500mm 3,640 m
Dia. 400mm 1,540 m
Dia. 300mm 1,680 m
Dia. 250mm 4,980 m

Table 10.2.2 Project Cost for Banias

Cost Item	Cost (10^3SP)
Construction Cost	
1) STP	462,954
2) PS	14,700
3) Pipes	86,550
Total of Construction Cost	**564,204**
Land Acquisition Cost	127,500
Engineering Cost	56,420
Government's Administration Cost	28,210
Organizational Development Cost	16,927
Physical Contingency	56,420
Sub Total	**285,477**
Price Contingency	211,007
Total (Excluding Price Contingency)	**849,681**
Total	**1,060,688**

(3) Deir-Ez-zor (Mayadin)

Project components

STP: Q=15,300 m^3/day (Oxidation Ditch Method), 1 place

PS: 2 places (Q=3.0 m^3/min)

Pipes: Dia. 800mm 1,000 m

Dia. 400mm 3,500 m

Table 10.2.3 Project Cost for Mayadin

Cost Item	Cost (10^3SP)
Construction Cost	
1) STP	295,200
2) PS	2,000
3) Pipes	28,250
Total of Construction Cost	**325,450**
Land Acquisition Cost	-
Engineering Cost	32,545
Government's Administration Cost	16,273
Organizational Development Cost	9,763
Physical Contingency	32,545
Sub Total	**91,126**
Price Contingency	113,248
Total (Excluding Price Contingency)	**416,576**
Total	**529,824**

(4) Hassakeh (Malkieh)

Project components

STP: Q=4,520 m^3/day (Oxidation Ditch Method), 1 place

Pipes: Dia. 500mm 100 m

Table 10.2.4 Project Cost for Malkieh

Cost Item	Cost (10^3SP)
Construction Cost	
1) STP	117,330
2) PS	-
3) Pipes	600
Total of Construction Cost	**117,930**
Land Acquisition Cost	-
Engineering Cost	11,793
Government's Administration Cost	5,897
Organizational Development Cost	3,537
Physical Contingency	11,793
Sub Total	**33,020**
Price Contingency	41,068
Total (Excluding Price Contingency)	**150,950**
Total	**192,018**

(5) Raqqa (Thawra)

Project components

STP: Q=17,890 m^3/day (Wet-land Method), 1 place

Pipes: Dia. 600mm 1,300 m

Dia. 500mm 100 m

Table 10.2.5 Project Cost for Thawra

Cost Item	Cost (10^3SP)
Construction Cost	
1) STP	182,485
2) PS	-
3) Pipes	11,000
Total of Construction Cost	**193,485**
Land Acquisition Cost	-
Engineering Cost	19,348
Government's Administration Cost	9,674
Organizational Development Cost	5,806
Physical Contingency	19,348
Sub Total	**54,176**
Price Contingency	67,889
Total (Excluding Price Contingency)	**247,661**
Total	**315,550**

(6) Dar'aa (Muzerib)

Project components

STP: Q=3,990 m^3/day (Wet-land Method), 1 place

Pipes: Dia. 500mm 4,000 m

Dia. 400mm 5,800 m

Table 10.2.6 Project Cost for Muzerib

Cost Item	Cost (10^3SP)
Construction Cost	
1) STP	58,636
2) PS	-
3) Pipes	50,100
Total of Construction Cost	**108,736**
Land Acquisition Cost	24,500
Engineering Cost	10,874
Government's Administration Cost	5,437
Organizational Development Cost	3,263
Physical Contingency	10,874
Sub Total	**54,946**
Price Contingency	35,107
Total (Excluding Price Contingency)	**163,682**
Total	**198,789**

(7) Rural Damascus (Zabadani)

Project components

STP: Q=22,200 m^3/day (Oxidation Ditch Method), 1 place

Pipes: Dia. 800mm 100 m

Table 10.2.7 Project Cost for Zabadani

Cost Item	Cost (10^3SP)
Construction Cost	
1) STP *1	509,300
2) PS	-
3) Pipes	1,250
Total of Construction Cost	**510,550**
Land Acquisition Cost	-
Engineering Cost	51,055
Government's Administration Cost	25,527
Organizational Development Cost	15,316
Physical Contingency	51,055
Sub Total	**142,953**
Price Contingency	127,523
Total (Excluding Price Contingency)	**653,503**
Total	**781,026**

*1) Not including removal cost of existing facilities and ground leveling cost.

10.3 Operation and Maintenance Cost

Annual O&M cost is estimated about the following items.

(1) Running Cost of STP and PS

The annual running cost of STP and PS assumed the following item.

- Personnel Expence
- Power (Electric Cost)
- Chemical Cost
- Repair and Maintenance
- Sludge Disposal etc

Two (2) to Three (3) percent of construction cost for STP and PS is applied. Three (3) percent is applied at the full load capacity.

(2) Running Cost of Pipes

The annual running cost of Pipes assumed the following item.

- Cleaning
- Dredging
- Repair etc

0.5 percent of construction cost for pipes is applied.

(3) Data Base

The cost to make a database for sewerage system, including data updating and purchase/renewal of computer and software is estimated on a lump sum basis at 1,000,000 SP every five year. In addition, the cost for ongoing and existing data renewal and research is estimated at 500,000 SP per year. Each price was defined in consideration of the market condition.

(4) Other Costs

These costs are for transportation, environmental monitoring and others, which were estimated at ten (10) percent of total O&M cost.

About the applied rate of each item, it was set up based on the track record and experience of the sewerage project in other countries.

The annual O&M cost is shown in **Table 10.3.1** ~ **Table 10.3.7**.

10.4 Implementation Schedule

A setup of the implementation and investment schedule for each project is based on the following assumption.

Project period :	2008 ~ 2025
Pre construction stage :	2009 ~ 2010
Construction stage :	2011 ~ 2013
O&M stage :	2014 ~ 2025

In the Master Plan, the high area of the enterprise effect is selected as an object area. In the selected area, branch sewers are already completed. That is, simultaneously with installation of a trunk sewer, more than 80% of sewage flows into a STP (at 2015). Therefore, a gradual building program of STP is not taken into consideration.
However, about Zabadani area in Rural Damascus which is the object of F/S, gradual building program is carried out according to the F/S report considering the possibility of early project implementation.

The implementation and investment schedule is shown in **Table 10.3.1** ~ **Table 10.3.7**.

Table 10.3.1 Implementation / Investment schedule and O&M cost for Slunfeh Project (Lattakia)

Implementation Schedule

Code	Description	Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Pre-Construction Stage																				
010	Preparation of Project (Feasibility Study, Financial Arrangement)																			
020	Pre-Construction (Detailed Design, P/Q and Tender)																			
Construction Stage																				
100																				
110	STP																			
120	PS																			
130	Pipes																			
500	Organizational Development																			
Operation & Maintenance Stage																				

Investment Schedule

		Total Cost (SP 1000)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
100	Construction Cost	111,544				46,652	64,892													
200	Land Acquisition Cost	1,000			1,000															
300	Engineering Service Cost	11,154			5,577	2,789	2,789													
400	Government's Administration Cost	5,577				2,333	3,245													
500	Organizational Development Cost	3,346				1,673	1,673													
600	Physical Contingency	11,154				4,665	6,489													
700	Price Contingency	33,651			727	11,073	21,850													
Total of Annual Disbursement		**177,427**			7,305	69,184	100,938													

32,232
143,776

Operation & Maintenance Cost

		Total Cost (SP 1000)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1100	Running Cost of STP and PS	25,753						1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717	2,575	2,575	2,575	2,575
1200	Running Cost of Pipes	1,542							129	129	129	129	129	129	129	129	129	129	129	129
1300	Data Base	9,500						1,500	500	500	500	500	1,500	500	500	500	500	1,500	500	500
1400	Othres	3,680						322	235	235	235	235	335	235	235	235	320	420	320	320
1500	Price Contingency	48,760						1,303	1,204	1,476	1,768	2,082	3,448	2,777	3,163	3,576	5,491	8,056	6,835	7,581
Total of Annual Disbursement		**89,235**						4,841	3,784	4,056	4,348	4,661	7,128	5,357	5,743	6,156	9,015	12,680	10,360	11,105

Table 10.3.2 Implementation / Investment schedule and O&M cost for Banias Project (Tartous)

Implementation Schedule

Code	Description	Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Pre-Construction Stage																				
010	Preparation of Project (Feasibility Study, Financial Arrangement)																			
020	Pre-Construction (Detailed Design, P/Q and Tender)																			
Construction Stage																				
100																				
110	STP																			
120	PS																			
130	Pipes																			
500	Organizational Development																			
Operation & Maintenance Stage																				

Investment Schedule

		Total Cost (SP 1000)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
100	Construction Cost	564,204				167,736	221,382	175,086												
200	Land Acquisition Cost	127,500			127,500															
300	Engineering Service Cost	56,420			28,210	9,403	9,403	9,403												
400	Government's Administration Cost	28,210				8,387	11,069	8,754												
500	Organizational Development Cost	16,926				5,642	5,642	5,642												
600	Physical Contingency	56,420				16,774	22,138	17,509												
700	Price Contingency	211,007			17,220	39,624	74,493	79,669												
Total of Annual Disbursement		**1,060,688**			172,931	247,566	344,127	296,064												

285,477
849,681.1

Operation & Maintenance Cost

		Total Cost (SP 1000)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1100	Running Cost of STP and PS	133,743							9,553	9,553	9,553	9,553	9,553	9,553	9,553	9,553	14,330	14,330	14,330	14,330
1200	Running Cost of Pipes	4,760								433	433	433	433	433	433	433	433	433	433	433
1300	Data Base	9,000							1,500	500	500	500	500	1,500	500	500	500	500	1500	500
1400	Othres	14,750							1,105	1,049	1,049	1,049	1,049	1,149	1,049	1,049	1,526	1,526	1,626	1,526
1500	Price Contingency	210,238							5,674	6,601	7,907	9,306	10,807	13,599	14,140	15,988	26,156	29,248	34,696	36,116
Total of Annual Disbursement		**372,491**							17,832	18,135	19,441	20,841	22,341	26,234	25,674	27,523	42,944	46,036	52,585	52,904

Table 10.3.3 Implementation / Investment schedule and O&M cost for Mayadin Project (Deir-Ez-zor)

Implementation Schedule

Code	Description	Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Pre-Construction Stage																				
010	Preparation of Project (Feasibility Study, Financial Arrangement)																			
020	Pre-Construction (Detailed Design, P/Q and Tender)																			
Construction Stage																				
100																				
110	STP																			
120	PS																			
130	Pipes																			
500	Organizational Development																			
Operation & Maintenance Stage																				

Investment Schedule

		Total Cost (SP 1000)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
100	Construction Cost	325,450				97,977	128,497	98,977												
200	Land Acquisition Cost																			
300	Engineering Service Cost	32,545			16,273	5,424	5,424	5,424												
400	Government's Administration Cost	16,273				4,899	6,425	4,949												
500	Organizational Development Cost	9,764				3,255	3,255	3,255												
600	Physical Contingency	32,545				9,798	12,850	9,898												
700	Price Contingency	113,248			1,800	23,124	43,223	45,101												
Total of Annual Disbursement		**529,824**			18,072	144,476	199,673	167,603												

91,126
416,576.0

Operation & Maintenance Cost

		Total Cost (SP 1000)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1100	Running Cost of STP and PS	83,216							5,944	5,944	5,944	5,944	5,944	5,944	5,944	5,944	8,916	8,916	8,916	8,916
1200	Running Cost of Pipes	1,554								141	141	141	141	141	141	141	141	141	141	141
1300	Data Base	9,000							1,500	500	500	500	500	1,500	500	500	500	500	1500	500
1400	Othres	9,377							744	659	659	659	659	759	659	659	956	956	1,056	956
1500	Price Contingency	133,299							3,821	4,145	4,965	5,845	6,787	8,981	8,880	10,041	16,379	18,315	22,524	22,616
Total of Annual Disbursement		**236,445**							12,010	11,389	12,209	13,088	14,031	17,325	16,124	17,285	26,892	28,828	34,137	33,129

Table 10.3.4 Implementation / Investment schedule and O&M cost for Malkieh Project (Hassakeh)

Implementation Schedule

Code	Description	Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Pre-Construction Stage																				
010	Preparation of Project (Feasibility Study, Financial Arrangement)																			
020	Pre-Construction (Detailed Design, P/Q and Tender)																			
Construction Stage																				
100																				
110	STP																			
120	PS																			
130	Pipes																			
500	Organizational Development																			
Operation & Maintenance Stage																				

Investment Schedule

		Total Cost (SP 1000)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
100	Construction Cost	117,930				35,199	46,932	35,799												
200	Land Acquisition Cost																			
300	Engineering Service Cost	11,793			5,867	1,956	1,986	1,986												
400	Government's Administration Cost	5,897				1,760	2,347	1,790												
500	Organizational Development Cost	3,538				1,179	1,179	1,179												
600	Physical Contingency	11,793				3,520	4,693	3,580												
700	Price Contingency	41,067			649	8,311	15,785	16,322												
Total of Annual Disbursement		**192,018**			6,515	51,924	72,922	60,656												

33,020
150,950.4

Operation & Maintenance Cost

		Total Cost (SP 1000)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1100	Running Cost of STP and PS	32,852							2,347	2,347	2,347	2,347	2,347	2,347	2,347	2,347	3,520	3,520	3,520	3,520
1200	Running Cost of Pipes	36							3	3	3	3	3	3	3	3	3	3	3	3
1300	Data Base	9,000							1,500	500	500	500	500	1,500	500	500	500	500	1500	500
1400	Othres	4,189							385	285	285	285	285	385	285	285	402	402	502	402
1500	Price Contingency	58,969							1,976	1,794	2,149	2,529	2,937	4,558	3,843	4,345	6,894	7,709	10,716	9,519
Total of Annual Disbursement		**105,047**							6,211	4,928	5,283	5,664	6,071	8,793	6,977	7,480	11,319	12,134	16,242	13,945

Table 10.3.5 Implementation / Investment schedule and O&M cost for Thawra Project (Raqqa)

Implementation Schedule

Code	Description	Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Pre-Construction Stage																				
010	Preparation of Project (Feasibility Study, Financial Arrangement)																			
020	Pre-Construction (Detailed Design, P/Q and Tender)																			
Construction Stage																				
100																				
110	STP																			
120	PS																			
130	Pipes																			
500	Organizational Development																			
Operation & Maintenance Stage																				

Investment Schedule

		Total Cost (SP 1000)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
100	Construction Cost	193,485				54,745	78,494	60,245												
200	Land Acquisition Cost																			
300	Engineering Service Cost	19,348			9,124	3,591	3,316	3,316												
400	Government's Administration Cost	9,674				2,737	3,925	3,012												
500	Organizational Development Cost	5,805				1,935	1,935	1,935												
600	Physical Contingency	19,348				5,475	7,849	6,025												
700	Price Contingency	67,889			1,009	13,050	26,390	27,441												
Total of Annual Disbursement		**315,550**			10,133	81,533	121,909	101,974												

54,176
247,660.7

Operation & Maintenance Cost

		Total Cost (SP 1000)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1100	Running Cost of STP and PS	51,096							3,650	3,650	3,650	3,650	3,650	3,650	3,650	3,650	5,475	5,475	5,475	5,475
1200	Running Cost of Pipes	660							55	55	55	55	55	55	55	55	55	55	55	55
1300	Data Base	9,000							1,500	500	500	500	500	1,500	500	500	500	500	1500	500
1400	Othres	6,076							520	420	420	420	420	520	420	420	603	603	703	603
1500	Price Contingency	85,951							2,672	2,647	3,170	3,732	4,333	6,162	5,670	6,411	10,333	11,555	14,998	14,268
Total of Annual Disbursement		**152,782**							8,397	7,272	7,796	8,357	8,959	11,888	10,295	11,036	16,966	18,187	22,730	20,900

Table 10.3.6 Implementation / Investment schedule and O&M cost for Muzerib Project (Dar'aa)

Implementation Schedule

Code	Description	Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Pre-Construction Stage																				
010	Preparation of Project (Feasibility Study, Financial Arrangement)																			
020	Pre-Construction (Detailed Design, P/Q and Tender)																			
Construction Stage																				
100																				
110	STP																			
120	PS																			
130	Pipes																			
500	Organizational Development																			
Operation & Maintenance Stage																				

Investment Schedule

		Total Cost (SP 1000)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
100	Construction Cost	108,736				48,504	60,232													
200	Land Acquisition Cost	24,500			24,500															
300	Engineering Service Cost	10,874			5,437	2,718	2,718													
400	Government's Administration Cost	5,437				2,425	3,012													
500	Organizational Development Cost	3,262				1,631	1,631													
600	Physical Contingency	10,874				4,850	6,023													
700	Price Contingency	35,107			3,311	11,458	20,338													
Total of Annual Disbursement		**198,789**			33,248	71,587	93,954													

54,946
163,682.0

Operation & Maintenance Cost

		Total Cost (SP 1000)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1100	Running Cost of STP and PS	17,591						1,173	1,173	1,173	1,173	1,173	1,173	1,173	1,173	1,173	1,759	1,759	1,759	1,759
1200	Running Cost of Pipes	3,006							251	251	251	251	251	251	251	251	251	251	251	251
1300	Data Base	9,500						1,500	500	500	500	500	1,500	500	500	500	500	1500	500	500
1400	Othres	3,010						267	192	192	192	192	292	192	192	192	251	351	251	251
1500	Price Contingency	39,572						1,082	987	1,211	1,450	1,707	3,013	2,277	2,593	2,932	4,301	6,726	5,354	5,938
Total of Annual Disbursement		**72,679**						4,022	3,103	3,326	3,566	3,822	6,228	4,393	4,709	5,048	7,061	10,586	8,115	8,699

Table 10.3.7 Implementation / Investment schedule and O&M cost for Zabadani Project (Rural Damascus)

Implementation Schedule

Code	Description	Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Pre-Construction Stage																				
010	Preparation of Project (Feasibility Study, Financial Arrangement)																			
020	Pre-Construction (Detailed Design, P/Q and Tender)																			
Construction Stage																				
100																				
110	STP																			
120	PS																			
130	Pipes																			
500	Organizational Development																			
Operation & Maintenance Stage																				

Investment Schedule

		Total Cost (SP 1000)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
100	Construction Cost	510,550			110,639	257,297	138,257					4,356								
200	Land Acquisition Cost																			
300	Engineering Service Cost	51,055		25,247	6,915	12,686	5,771				218	218								
400	Government's Administration Cost	25,527			5,532	12,865	6,913					218								
500	Organizational Development Cost	15,316			3,319	7,719	4,148					131								
600	Physical Contingency	51,055			11,064	25,730	13,826					436								
700	Price Contingency	127,523		909	15,203	60,272	46,667				149	4,323								
Total of Annual Disbursement		**781,026**		26,156	152,672	376,568	215,581				367	9,681								

142,954
653,503.4

Operation & Maintenance Cost

		Total Cost (SP 1000)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1100	Running Cost of STP and PS	219,041						14,821	15,160	15,500	15,840	16,180	16,519	16,859	17,199	17,530	17,861	18,193	18,524	18,855
1200	Running Cost of Pipes							6	6	6	6	6	6	6	6	6	6	6	6	6
1300	Data Base	9,500						1,500	500	500	500	500	1,500	500	500	500	500	1500	500	500
1400	Othres	22,862						1,633	1,567	1,601	1,635	1,669	1,803	1,737	1,771	1,804	1,837	1,970	1,903	1,936
1500	Price Contingency	298,022						6,612	8,042	10,076	12,325	14,809	18,578	20,561	23,875	27,501	31,477	37,749	40,601	45,815
Total of Annual Disbursement		**549,506**						24,572	25,276	27,683	30,306	33,163	38,406	39,663	43,350	47,341	51,682	59,418	61,534	67,112

10.5 Organization and Management Plan

10.5.1 Introduction

As stated earlier, the water supply and sewerage sector in Syria is managed by the governorate-wide organizations, the Public Establishments of Drinking Water and Sewerage (Establishments) under MHC. In the governorates where STPs have been implemented, MHC has established the Sewerage Companies (Companies) for operation and maintenance of sewerage systems. The local administration does not have any responsibility for water supply, but design and implementation of sewer networks belong to the municipalities until the time when the STP is implemented. However, the responsibility to design and implement the sewer networks is confusing because the municipalities' design objectives are too narrow – to transfer wastewater downstream.

The Companies have been established for sewerage management in the five Governorates to own, operate and manage sewerage infrastructure. The owner of the Companies is MHC, however, they are organizationally controlled by the Establishments. Recently, it has been decided that the new Company will be established in the Governorate of Rural Damascus.

10.5.2 Organization Structure for Implementation and O&M of Sewerage System

The life of a sewerage project can be divided into the following phases.

- Project formation phase
- Project implementation phase (including project preparation stage, pre-construction stage and construction stage)
- Operation and maintenance phase

The JICA Study Team recommends that these all phases of sewerage projects be controlled by one Ministry, i.e. MHC, and the central Ministry should concentrate on supervising the performance of the sector and on the project formation through establishing the national priority. The project implementation and the operation and maintenance should be managed by the Establishment and the Company, respectively, in accordance with the Minister Decree No. 14/1984.

(1) Project Implementation Phase

The project implementation phase is comprised of the project preparation stage, the pre-construction stage and the construction stage. The project preparation stage includes preparation of F/S, financial arrangement, and the pre-construction stage includes preparation of basic and detailed design, pre-qualification and tender documents, and tender execution. The construction stage includes construction supervision, financial management and handing-over of the completed facilities.

For the seven projects in the target Governorates, a total period of 5-8 years has been forecasted

to cover all such activities. It is estimated that the project preparation and pre-construction stage require one year and two years, respectively, while 3-6 years are required for the construction of proposed facilities depending on the size of the project.

To execute these tasks, it is proposed that the Establishment, as the implementing agency, set up a Project Management Unit (PMU) within the structure of the Establishment. The existing directorates such as Design and Study Dirctorate and Execution Directorate could be integrated into the new PMU. Other relevant directorates (e.g. Planning and Statistic Directorate, Investment and Maintenance Directorate, Financial Affairs Directorate, Subscribers' Affairs Directorate) may also be integrated in order to facilitate teamwork and smooth implementation of management process. This new PMU could be a temporary organization for executing the proposed project, but it is desirable to found a permanent Unit in the future so that it will be able to deal with different projects.

An international consultant needs to be assigned in order to support the PMU. Their tasks are to assist the PMU by providing consulting services in preparing design and tender documents, procuring goods and services, executing construction supervision, financial management, and handing-over of the facilities.

(2) Operation and Maintenance Phase

In principle, operation and maintenance of the sewerage facilities should be carried out by the Sewerage Company (Company) in each Governorate. Therefore, when the proposed project is started, a new Company needs to be founded as soon as possible in the Governorates where the Company has not been established yet, so that the facilities will be taken over to the new Company.

However, it is not easy to establish a new Company in a short period because it entails the asset transfer of existing sewers from the municipality to the Company and recruiting the new technical staff of a significant number. According to the Establishment of Rural Damascus, it would take some 5 years to arrange such requirements for establishing of the new Company.

In this regard, there could be an option that the PMU in the Establishment will take care of operation and maintenance of the completed facilities for the time being until a new Company is ready for set up. In such a case, a requirement for a certain period of facilities operation (more than 2 years are desirable) should be defined in the construction contract between the Contractor. To adopt a design-build-operation (DBO) contract could be another option.

However, the capacity of the technical staff concerned should be strengthened in order to cope with the required tasks and large work volume that will be needed for construction and O&M of the proposed new sewerage facilities. Furthermore, management and administrative capacity of the Company, as an autonomous entity under the Establishment, has to be strengthened in

order to carry out not only the daily operations and maintenance, but also facility planning, development and rehabilitation of the sewerage system. In this viewpoint, implementation of a technical assistance program for the Sewerage Company (and other technical staff) is proposed. Details are discussed in **Section 10.6**.

In summary, an outline of the proposed organization structure for implementation and O&M of sewerage system is illustrated as shown in **Figure 10.5.1**. Proposed member of Steering Committee is MHC, MLAE, MOI, SPC, Governorates, City Council and GCEC. As Sewerage Company was only established in Lattakia Governorate so far, it shall be formulated in the remaining six Governorates.

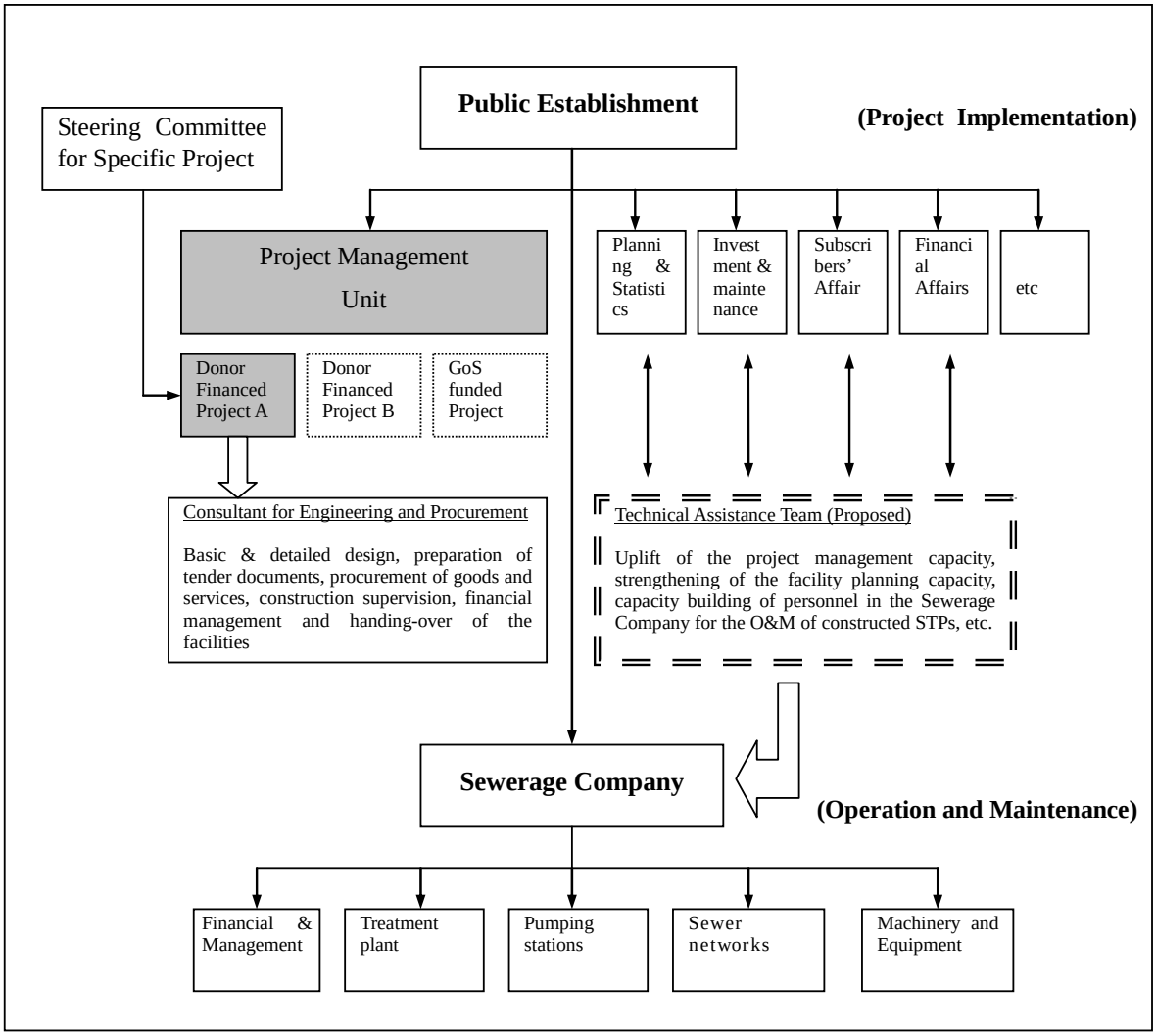

Figure 10.5.1 Proposed Organization Structure for Sewerage Project Implementation and O&M

10.5.3 Management Plan for Sewerage System in the Target Seven Governorates

The management plan for the sewerage system is common to the target seven Governorates. Systems operation and maintenance will be implemented by the new Sewerage Company to be established for each Governorate. This section discusses the main point for operation and maintenance of the sewerage system.

(1) Considerations for Operation and Maintenance

1) Basic Consideration

The works for O&M of sewerage facilities can be divided into two categories based on work frequency and scale. One is large- scale, seldom occurring works, such as replacement and upgrading of major mechanical facilities, and the other for small and routine works, such as cleaning facilities and small repair works. Large-scale O&M work requires a large investment for special (high priced) machinery and a substantial workforce, which seldom occurs. Consequently, maintaining these machines and workforce by the Company will certainly bring down the company's operations and efficiency due to low utilization. Although the sewerage facilities are to be expanded, it is rational, as in the scheme employed presently, that the Company carries out routine and rather small-scale works, and other rather large- scale, rarely occurring works is contracted out to the private sector.

2) Sewer Operation and Maintenance

The existing Companies have been carrying out O&M works on the sewers only when a complaint about pipe clogging is raised by customers. In the Governorates with no Sewerage Company, such works are carried out by the municipality. In order to keep the facilities in a good condition, however, the preventive maintenance is essential. A sewer network will lose its principal function such as smooth sewage flow if blockage of sewer pipes occurs by accumulation of sludge and appropriate condition if offensive odor and/or toxic gases are emitted by accumulated sludge. In this regard, periodical cleaning is indispensable to maintain smooth sewage flow, and every sewer should be cleaned at least once five years. Generally, sewer cleaning is carried out by combination of high pressure equipment, a vacuum cleaner and a water tanker as follows (Refer to **Figure 10.5.2**):

- Accumulated sludge is washed out to manhole in downstream by pressurized jetting water supplied from high pressure cleaning equipment.
- Drained sludge in manhole is sucked by a vacuum cleaner

For Damascus Sewerage and Sanitation Company (DSDC), however, a Japanese expert was dispatched to DSDC as a JICA technical cooperation program, and it contributed to improvement of sewer maintenance skills in DSDC. Therefore, such maintenance skills should be transferred by the DSDC staff to other Companies through training opportunities.

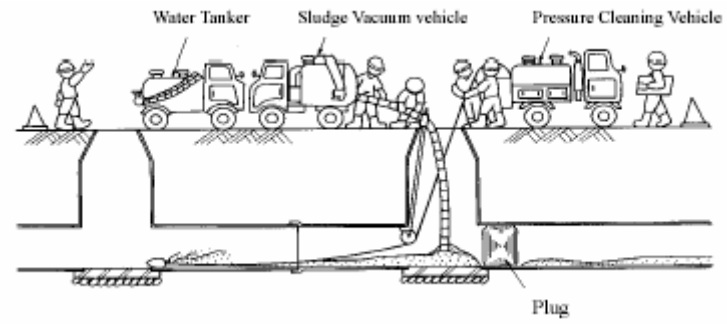

Figure 10.5.2 Mechanized Sewer Cleaning Equipment

3) Pump Stations

For responsible and adequate performance in operation and maintenance of pumping stations, the pump station section/unit shall concentrates on routine works, while the high level technical and engineering aspect such as overhauls of major mechanical/ electrical facilities are to be contracted out to qualified companies. The maintenance works are classified into daily inspection, periodic inspection and cleaning work. The works include:

a. Daily Inspection

- Inspection of operating conditions of pumps
- Visual observation of pump pits and control panels
- Starting test of protection devices such as a circuit breaker

b. Periodic Inspection

- Verification of fix and unfix functions of submerge pumps
- The start-up test of pumps by level switches
- The insulation resistance test for electric equipment
- Overhauls of pump unit shall be contracted out
- Regular change of spare parts

c. Cleaning Work

Periodic cleaning work for the pump stations is necessary to remove debris, garbage, sand and scum accumulated in the pump pits. The cleaning work includes removal of such solid wastes and washing out the pits.

4) Sewage Treatment Plant

STPs have to be operated and maintained so that both the sewage and sludge treatment facilities can give full play to their functions. The O&M activities for STPs include operation, control, inspection and maintenance of the plant, water quality test and sludge disposal. In order to sustain sound functions and to prevent accidents of the facilities, the preventive maintenance is indispensable and an adequate maintenance plan needs to be established. As a result of implementing the planned maintenance, the plan needs to be reviewed since there may be a case that contents and frequency for some activities are not appropriate. Also, results of

maintenance activities must be recorded so as to make full use for the repairs and rehabilitations in the future stage.

The outline of a maintenance plan is presented in **Figure.10.5.3**.

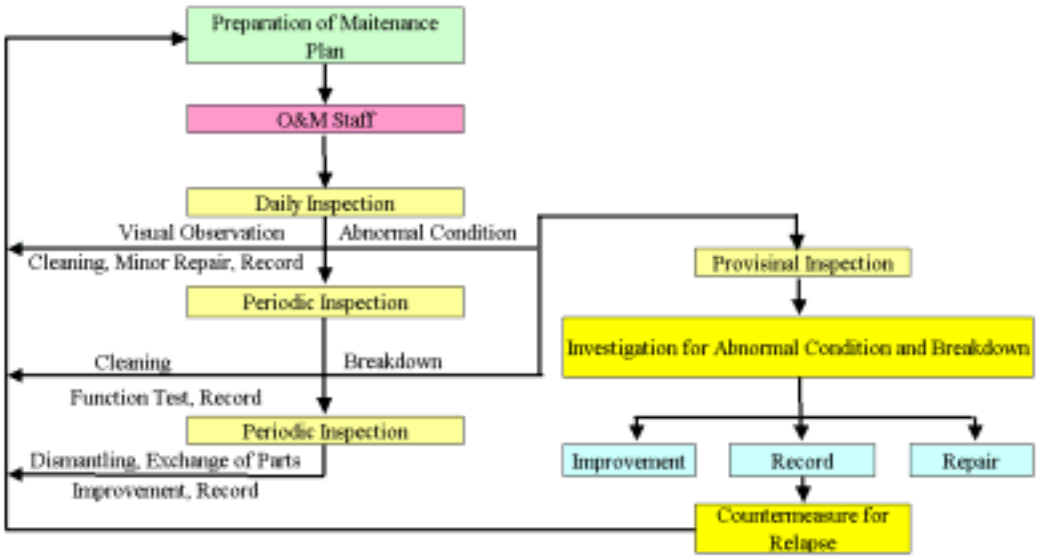

Figure 10.5.3 Outline of a Maintenance Plan

5) Water Quality Control

The Company should perform water quality test of both the influent and effluent to check and monitor the pollution levels of influent as well as operating conditions and removal efficiency of the treatment facilities under the requirement of the water quality regulations. For this purpose, it is vital to conduct routine water quality test. In addition, monitoring the quality of industrial wastewater is also an important task to secure proper operation of the system.

10.5.4 Recommendations

Proficient engineering and operational knowledge are required to the staff for O&M of the proposed sewerage facilities. The Company is required to have specialized engineers of each facility in order to attain total effective and efficient engineering. In Syria, however, there is a shortage of such engineers (specializing in pumping stations, sewage treatment plants and general facility planning) and difficulty in recruiting qualified persons. Consideration has to be taken in strengthening the capability of staff through training programs and facilitating usage of engineering tools. The following recommendations are made to uplift the capacity of the Company.

1) Training

The Company's workforce should have basic knowledge on the job assigned to them. To uplift

their capability and knowledge, training programs for the staff should be implemented at least with respect to the following subjects:

- Basic knowledge on sewage treatment and sewerage system
- Operation and maintenance of sewerage facilities

The training programs on these subjects should include both the classroom training and on –the-job training. Basic knowledge on the sewage treatment and sewerage system shall be provided through the classroom training, and all the staff should acquire the basic knowledge from this training. The on-the-job training shall be implemented for the staff already acquiring the basic knowledge, by using existing sewerage facilities in operation.

It is essential to get the services of trainers/lecturers having sufficient background in their respective fields. It is suggested to invite eligible Japanese experts to carry out these courses, as a wealth of experience and know-how in O&M of the proposed sewerage system are available in Japan.

2) Keeping Records

As stated earlier, maintaining work records will help strengthen control over all works accomplished. It is also useful for review purposes and in identifying past problems and solutions, serving as reference should similar situations occur in the future. It is recommended to file such important information for future reference. Important records to be kept include the following:

- Sewer pipe, manhole inspection and maintenance records including sewer replacement works
- House-connection
- Treatment plant inspection, operation and maintenance
- Pump station inspection, operation and maintenance
- Water quality inspection and examination
- Stock in-out records. In addition to the semi-annual stock records, annual inventory should also be taken.
- Maintenance records of vehicles, machines, equipment, tools, etc.

10.6 Recommendation on Applicable Aid Program

10.6.1 Consideration for Necessary Technical Assistance

From the findings of the Study, the need for technical assistance (TA) to the sewerage sector in Syria are summarized as follows:

(1) Institutional, Administrative Aspects

The current fragmented, overlapped and inefficient administration structure of the sewerage sector in Syria needs to be improved. To challenge this issue, the 10th FYP declares that the water and sewerage services administration will be unified to MHC, and the organization of

MHC will be restructured to separate its functions into the Regulator (central Ministry) and Executor (Establishment). Also, the FYP states to reform the Establishments so that all the water and sewerage services in Syria are provided through the highly efficient Establishments, and they manage by themselves as an autonomous public company.

For these purposes embedded in the FYP, GTZ is currently providing technical support to MHC in order to meet the requirements of the FYP, as mentioned in Chapter 4. The services of the technical support include five components, namely, 1) Monitoring and evaluation, 2) Economic and financial management, 3) Management of strategic planning and communication, 4) Project development and management, and 5) Human resources management.

The JICA Study Team considers that most of the institutional, administrative arrangement surrounding the water and sewerage sector would be fulfilled through their support. Therefore, it seems that assistance for the institutional, administrative aspects from Japan is unnecessary.

(2) Technical Aspect

1) Planning and Design of Facilities

The Directorate of Sewerage in MHC has been handling planning, design and construction of sewerage facilities such as STPs, pumping stations and trunk mains. In many cases, however, actual works are commissioned to GCEC, which is a 100% Government owned consulting company. Therefore, the staff of MHC is not fully familiar with the planning and design technologies of the sewerage facilities. Moreover, the design documents taken over from GCEC have not been properly preserved in their library. On the other side, the JICA Study Team observes that the planning and design manner of GCEC is old-fashioned and of stereotype. For instance, they are apt to adopt a large-scale centralized sewerage system without comparing to other possible options when they study a sewerage master plan for a specific region. In addition, they not have authorized technical standards or guidelines that should be applied for planning and design of facilities nationwide. Practically, Russian guidelines used to be referred to in preparing MPs and the facility planning when Russian experts cooperated with GCEC for planning and design of sewerage facilities. Presently, American technical publications are being applied for design of STPs.

Considering such situations, uplift of the planning and design skills in technical staff of the Syrian sewerage sector is needed in order to develop sewerage systems by their own efforts in the future.

2) Operation and Maintenance

MHC and the Sewerage Companies have good experience in implementation of O&M for the existing sewerage systems in the Governorates where STPs are in operation such as Damascus, Aleppo, Hama and Homs. However, their O&M activities and capacities for the existing

systems are not sufficient because the systematic and preventive maintenance have not been carried out due to lack of knowledge and skills of the O&M staff.

For example, the sewer maintenance section in DSDC have been busily occupied only in dealing with complaints from customers, which took place 4,800 times per year and most of which were on overflow troubles due to pipe clogging. They neither practiced regular pipe inspections nor sewer cleaning work. In an attempt to improve these situations, a Japanese pipeline expert was dispatched to DSDC as a JICA technical cooperation program, and it contributed to improvement of sewer maintenance skills in DSDC.

As for the treatment plant, although the staff of Adraa STP do not feel any problems on their daily O&M activities, they are not satisfied in terms of the provision of O&M manuals and training system. In addition, they are aware of the necessity to address the following challenges.

- Capacity build up towards introducing the nitrogen and phosphorous removing system for reuse of the treated water
- Intestinal helminthes eggs removal technology
- O&M technology of mechanical dewatering systems

For these issues and challenges, the Syrian side expects to implement a technical assistance program.

The JICA Study Team considers that appropriate O&M of STPs is one of the most important technical issues that should be sustained, because it is connected directly with whether the STP can produce the treated sewage of the required quality. Syria is seriously lacking in trained O&M staff of STPs throughout the country, since the number of operating STPs is very limited at present. In this regard, training for raising the trainers of O&M, who will in turn train the new trainees in the future, would be crucial. In addition, nitrogen removal is a key issue for the protection of groundwater quality and treated water reuse for the agricultural purposes, and it needs more skilled O&M technology compared to the existing conventional activated process in Adraa STP. The staff of STP section therefore needs to be fully knowledgeable and trained in operation of such treatment processes, which are ordinarily practiced in many municipalities in Japan etc.

In the above-mentioned context, it is suggested that a training program on STP O&M by skilled engineers be implemented as a technical cooperation program.

3) Water Quality Management

The capacity development program of environmental monitoring for MLAE has just been carried out by the JICA expert team. It has set up the 14 Governorate's monitoring center and will contribute to improvement of the analytical technique in the environmental inspection process.

Apart from the environmental monitoring executed by the environmental sector, the main activities of water quality management in the STPs are classified into two aspects. One is to detect and control the discharge of potentially polluting industrial wastewater and to check the operating conditions of treatment facilities. The other is to monitor the quality of treated sewage whether it meets the legal standards. Currently STPs in Syria are periodically monitoring the water quality of influent and effluent as a whole, and sampling and analysis of industrial discharge is sometimes carried out. Such activities are done as a routine work of the laboratory department in each STP.

However, all the O&M staff should acquire the basic knowledge on the biological purification mechanism together with the water quality including sludge index to ensure proper operation of each treatment unit composing the STP. In this regard, a basic water quality curriculum should be included in the suggested training program mentioned above.

10.6.2 Proposed Technical Aid Program

According to the Director of Training Division of MHC, they dispatched their staff to abroad such as Germany, Egypt, Jordan and Tunisia to attend technology transfer seminar there. They planned to assign these staffs to Adraa Training Center to train other staff by On the Job Training. They also have future plan to build another training center in Hama STP. However, these staffs just returned to their offices after the seminar without any technology transfer.

So far, MHC's training program has been yielded no remarkable outputs and it was supposed that there will be no drastic improvement in current status of this field. As they don't have any qualified training staff, they still need foreign support in this line.

The following technical cooperation project is proposed to be an appropriate assistance, based on the considerations presented earlier.

(1) Project Name

The Project for Improvement of Sewage Treatment Plant Management in the Syrian Arab Republic

(2) Background and Objectives

In Syria, the sewage treatment is practiced in the four major cities with large population, Damuscus, Aleppo, Homs and Hama, together with several small-scale STPs in rural areas. Other cities and areas are not equipped with sewage treatment facilities although sewer networks are in place, and untreated wastewater is being discharged into public waters such as rivers, ocean areas and groundwater, causing aggravation of living, sanitary and environmental conditions. Further, deterioration of groundwater due to the discharge of inadequate treated sewage has been recognized as a recent problem. As well as the problem in groundwater quality,

groundwater storage volume is decreasing as stated in **Figure 3.4.4** in Main Report. This owes to inefficient water usage such as leakage from water supply pipe, illegal well construction and illegal water pipe connection. Systematic pipe replacement planning and legal enforcement to illegal users shall be executed immediately.

In order to uplift the life of quality and environmental performance, developing the sewerage system throughout the country is one of the Syrian national policies embedded in the 10th FYP, and it has been tackled mainly led by MHC and MLAE. It is worthwhile to promote sewerage systems development which will greatly contribute to water pollution control, effective utilization of water sources. This Project is to support the effective implementation of such sewerage works in Syria.

(3) Contents of Assistance

With a purpose of improvement in operating conditions of the existing STPs in Syria, the Project shall be implemented in Adraa STP, which has not been functioning satisfactorily, as a pilot plant. The contents of the Project shall include repair/improvement of malfunctioning facilities, improvement of O&M activities for these facilities, preparation of O&M manuals for STPs, and provision of training for relevant personnel. The contents of manuals and training shall include the practical knowledge that is obtained through the actual activities in Adraa STP, so that it can be applied to other STPs in the future. Also, such technical transfer shall include not only O&M technologies but also those for planning and design of facilities, so that Syrian staff absorbs skills on sewerage works from the planning stage to the O&M stage.

(4) Expected Duration of Assistance

From April 2009 to April 2012 (three years)

(5) Syrian Side Counterpart

Damascus Sanitary Drainage Company (DSDC)

(6) Project Site

Adraa STP

The existing training facility shall be utilized for this Project. The facility has a lecture room (30 seats), a computer room (10 computers), and a language education room (10seats).

(7) Experts Assignment

1. Team Leader/Sewage Treatment Specialist
2. O&M Specialist (Mechanical)
3. O&M Specialist (Electrical)

4. Water Quality Specialist
5. Facility Planning Specialist (Civil)
6. Facility Planning Specialist (Mechanical/Electrical)

(8) Project Beneficiaries

Directly 800 staff of DSDC, indirectly 1.5 million citizens who rely on Adraa sewerage system.

(9) Training Method and Contents

1) On the Job Training (OJT)

This includes training for the overall O&M activities in the STP. The experts shall conduct instruction to the O&M staff on the following matters through the daily O&M work.

a. General Matters

- Development of operation and maintenance manual
- Establishment of system to respond to normal, abnormal, and emergency cases
- Arrangement of design and completion documents
- Recording of operation conditions and inspection results in daily logs
- Grasping of power and fuel consumptions
- Observance of related laws and regulations

b. Renewal and Repair

- Establishing of a reconstruction/rehabilitation implementation plan
- Implementing of minor renewal and repair of malfunctioning equipment

c. Troubleshooting for Treatment Facilities

d. O&M of Electrical Equipment

e. Water Quality Control

- Water quality monitoring for judging the adequacy of treatment functions
- Water quality monitoring for judging the legal compliance
- Water quality monitoring for judging the illicit wastewater inflow
- Keeping and maintenance of monitoring records

2) Classroom Training

Prior to implementation of the classroom training, the experts shall prepare a training kit. The training shall consist of four courses, and the training for each course shall be periodically provided by the experts throughout the project implementation. The following curriculum is proposed for the classroom training

a. Planning and Design of Treatment Plant

- Basic plan of sewage facilities
- Principle of sewage treatment
- Design of the sewage treatment plant
- Design exercises

b. Planning of Mechanical and Electrical Equipment

- Basic plan of sewerage facilities

- Principle of sewage treatment
- Machines for sewage treatment
- Electric equipment for sewage treatment
- Design exercises

c. Operation and Maintenance of STP

- Principle of sewage treatment
- Operation control of the sewage treatment facilities
- Machine operation control for sewage treatment exercises
- Operation control of electric equipment and appurtenances
- Data control and maintenance
- Safety rules
- Field exercises

d. Water Quality Control

- Principle of sewage treatment
- Biology and chemistry for sewage treatment
- Outline of water quality analysis
- Treatment facilities inspection and inspection standards
- Effluent surveys
- Discharge permission procedure
- Field exercises

(10) Project Schedule

A proposed project schedule is shown in **Table 10.6.1**.

Table 10.6.1 Proposed Project Implementation Schedule

Items and Descriptions	FY 2009				FY 2010				FY 2011				FY 2012
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I
1. On the Job Training													
a. General matters													
b. Renewal and repair													
c. Troubleshooting for treatment													
d. O&M of electric equipment													
e. Water quality control													
2. Classroom Training													
Preparation of training kit													
a. Planning and design of STP													
b. Planning of M&E equipment													
c. O&M of STP													
d. Water quality control													
3. Project evaluation and review													

CHAPTER 11 ECONOMIC AND FINANCIAL ANALYSIS

11.1 Methodology of Economic Analysis

11.1.1 Introduction

The M/P sewerage system development project is designed first of all to contribute to the public welfare. For this reason, profitability can hardly be construed as the paramount objective of this project. Although the project is likely to encounter difficulties in financial cost recovery it promises to brings about a significant number of social and economic benefits to the served population. Therefore, the Economic Internal Rate of Return (EIRR) approach was used for project justification. Particular efforts were made to estimate the EIRR for each of the seven M/P priority areas, as well as for the M/P in totality.

11.1.2 General Assumptions of the Economic Analysis

In the calculation of the EIRR, the project life span was measured to coincide with the length of the project design period, i.e. through the year 2025 for all priority areas.

The domestic currency (Syrian Pound) at the domestic price level was used as numeraire for the economic analysis.

All flows of economic costs and benefits were taken in nominal prices. Following the same assumption taken for the cost estimation, an inflation rate of 7.2% p.a. was applied to the flows of economic costs and benefits.

The project costs, excluding the assumed overall tax of 5% plus incremental (i.e. a difference between “with project” and “without project” scenarios) O&M costs throughout the project life, represent the economic costs.

Only quantifiable economic benefits can be taken into account while arriving at the EIRR figures. Many potential economic benefits of improving the sewerage treatment and disposal are not readily quantifiable, especially in economic terms, despite the efforts made to estimate them. Details of the quantified economic benefits are described below. It should be noted that since many economic benefits were left unquantified, the calculated EIRRs are rather conservative estimates.

11.1.3 Tourism Development Economic Benefits

Syria in general and some of the M/P priority areas in particular are considered as important destinations for tourists coming to Syria. Since the exact figures are not readily available, the following estimates were made regarding the number of tourists visiting the M/P priority areas

based on the assessments made by the Director of Planning of the Ministry of Tourism:

Table 11.1.1 Estimated Number of Tourists per M/P Priority Area

Governorate	Existing number of tourists per Governorate (Person)	Percentage relating to M/P priority area	Existing number of tourists per M/P priority area (Person)
Lattakia	660,000	70%	462,000
Tartous	440,000	50%	220,000
Deir-Ez-zor	30,000	40%	12,000
Hassakeh	10,000	60%	6,000
Raqqa	10,000	60%	6,000
Dar'aa	200,000	100%	200,000
Rural Damascus	1,900,000	60%	1,140,000

The Ministry of Tourism expects that, after the implementation of the M/P project, the existing number of tourists will increase in the respective M/P priority areas by as much as 50%. However, taking into account that attracting new tourists is a comprehensive task that requires the coordinated action among sectors involved in many areas, the implementation of a new sewerage system may not lead to this expected result, if not supported by other measures. Therefore, it was prudently assumed that the increase in the number of tourists due to the sewerage system implementation, will account for 5%.

Furthermore, according to the Ministry of Tourism, each tourist spends approximately USD 500, or SP 25,000 in current prices, during his/her stay in Syria. Therefore, even assuming that the average mark-up of the Syrian tourism sector is 5%, the economic benefits for the national economy derived from each tourist arrival were estimated as SP 1,250.

11.1.4 Health Economic Benefits

The health benefits were estimated based on the expected reduction of economic losses related to incidence of waterborne and water-related diseases (e.g. typhoid, hepatitis, dysentery, gastroenteritis, cholera and others). Benefits of reducing two kinds of losses were quantified, such as (1) reducing the cost of productive time lost and (2) reducing medical expenditures.

(1) Productive Time Lost

According to the Ministry of Health, 2,574 cases of hepatitis, 4,029 cases of salmonella, 171,422 cases of hemolytic/ non-hemolytic diarrhea, and 7,628 cases of acute diarrhea were officially registered in Syria in 2006. Assuming that each registered case of hepatitis and salmonella requires one month of treatment and each case of diarrhea – one week of treatment, it was estimated that approximately 3,800 person-years were lost due to the officially registered incidences of the water-borne and water-related diseases amongst the entire population of Syria. In addition to these official statistics, and based on interviews conducted with local employees, it was arbitrarily assumed that each person loses at least 3 days a year due to the waterborne and

water-related diseases, which are not registered officially. This leads to an additional 173,100 person-years lost (21,061,000 * 3 / 365), resulting in 176,900 person-years lost in total for the whole country.

It was assumed that this loss of person-years due to water-borne and water-related diseases was evenly distributed across the country. Therefore, only a share of this loss, which is equivalent to the share of the population of the respective M/P priority area compared to the total population of Syria, was taken into consideration. The economic cost of this productive time lost was valued using the average gross domestic income per capita in Syria of USD 1,380 (2005, World Bank), i.e. approximately SP 70,000 at the present.

Finally, assuming that the M/P sewerage project will allow a reduction in the incidence of waterborne and water-related diseases only by 40% (and accordingly, 60% was assumed to be caused by reasons other than the lack of a sewerage system), the economic benefits from the reduction of productive time lost was estimated at 40% of the losses attributed to the respective M/P priority areas. The figure of 40% as the achievable reduction after the sewerage project implementation was taken based on the World Development Report: Investing in Health (World Bank, 1993).

(2) Medical Expenditures

According to World Health Organization statistics, the per capita total expenditure on health in Syria accounts for USD 108.8 (2004), i.e. approximately SP 5,500. Since there is no reliable data on this matter, based on discussions with the Ministry of Health staff, it was assumed that only 15% of all medical expenditures, which is approximately SP 820 per capita annually, can be attributed to the treatment of waterborne and water-related diseases. Accordingly, this figure was applied to the number of population in the respective M/P priority areas to derive the total medical expenditures related to waterborne and water-related diseases. Finally, similar to the above-described case of reducing the cost of productive time lost, only 40% of these expenditures were taken as the expected economic benefits upon completion of the M/P project.

11.1.5 Economic Benefits of Using the Treated Wastewater

After implementation of the M/P in the priority areas, the treated wastewater is planned to be used for irrigation. Currently, either ground or surface water is used. However, ground water represents a scarce resource for most of the M/P priority areas and therefore, treated wastewater to be generated by the M/P project in these areas must be valued as the opportunity cost of the saved scarce resource – ground water, i.e. as the economic value of the ground water. While different methods can be used for the economic valuation of the saved ground water, discussion on which is beyond the scope of this study, one of the common methods employed is to use the willingness of water consumers to pay. It was assumed that the willingness of Syrian

customers to pay for their drinking water does not differ significantly from the existing lowest-tier tariff currently set at 3 SP/m^3. Therefore, the said 3 SP/m^3 was prudently applied as the economic value for the treated wastewater. It should be noted that this value might be underestimated.

In those M/P priority areas where ground water is not currently used for irrigation, river water, which does not represent a scarce resource is used instead (namely Deir-Ez-zor, Hassakeh and Raqqa). The treated wastewater was valued at the saved cost of pumping the river water for irrigation, which was estimated to be 0.5 SP/m^3 based on results of other studies in Syria.

11.1.6 Economic Benefits of Using Sludge as Fertilizer

The experience of the Damascus Sewage Treatment Plant confirms that the digested sludge produced by the plant can be sold as fertilizer for agriculture. Currently, the sludge is sold at 200 SP/m^3, which is assumed to be the market price for the valuation of economic benefits. It was also assumed that only a half of the sludge would be sold.

11.1.7 Non-Quantified Economic Benefits

A number of other economic benefits were not taken into account while calculating the EIRR such as, for instance, the reduced contamination of groundwater, downstream drinking water supply benefits, positive environmental impacts, increase in the value of land and real estate, enhanced opportunity for business development (apart from the tourism discussed separately), and so on, to mention a few, solely because they were not quantified.

11.2 Results of Economic Analysis of Master Plan

11.2.1 Results of EIRR Calculations

The results of the EIRR calculation for each of the seven priority areas of the M/P, as well as for the Mater Plan on the average, are summarized below:

Table 11.2.1 Results of EIRR calculation

Area	EIRR
Lattakia M/P priority area	25.5%
Tartous M/P priority area	3.2%
Deir-Ez-zor M/P priority area	14.7%
Hassakeh M/P priority area	11.4%
Raqqa M/P priority area	24.1%
Dar'aa M/P priority area	26.1%
Rural Damascus M/P priority area	18.0%
M/P Average	**15.0%**

The Net Present Value (NPV) for the entire M/P project at the discount rate of 10% was estimated as SP 764.6 million.

Details of the EIRR calculations, along with the assumptions that were made, are provided in Appendices 11.1 to 11.8. The calculated EIRRs should be interpreted with due caution taking into account that they were obtained using rough estimates of the capital and O&M costs. It should be also recalled that while arriving at the EIRR figures, all flows of economic costs and benefits were taken in the local currency after adjustment for inflation (7.2% p.a.).

11.2.2 Conclusions of the Economic Analysis

It follows from the above-provided results of the EIRR calculations, notwithstanding the conservativeness of the assumptions that were made, the M/P project as a whole is feasible from the economic point of view. The NPV of the M/P is positive (SP 764.6 million) and the average EIRR is 15.0%. In particular, the calculated EIRR for the Damascus Rural priority area is 18.0%, which is above the M/P average figure.

The economic benefits associated with tourism development, reduction of productive time lost and reduction of medical expenditures are the most significant validations for the entire M/P. However, the situation differs significantly from one priority area to another, depending on the number of population, attractiveness of the area for tourism development, availability of water resources and other circumstances. For instance, the benefits associated with the use of the treated wastewater are more significant in priority areas that are deficient in water resources.

11.3 Outline of the Financial Plan of the Master Plan Sewerage Project

11.3.1 Purpose and Assumptions of the Financial Plan

The main purpose of the project's financial plan is to ensure the financial viability of the proposed project. The financial plan should particularly determine the amount of funds required to finance the project, including the capital, O&M and financial costs, and the sources for these funds. Whereas a detailed financial plan will be prepared at the Feasibility Study stage only for the F/S priority area, the main ideas behind the financial plan that could be applicable to the entire M/P project are outlined in this section.

The capital costs of the M/P project could be financed from different sources, such as for instance, the Public Debt Fund (a subsidy of the Syrian Government), by taking loans from domestic and international markets, by grants from international donor agencies, and so on. The concrete sources could be determined at the later stage of the project development cycle.

It should be pointed out that the recovery of capital costs of sewerage projects through user charges occurs very rarely in the international practice and is not on the agenda of the Government of Syria in the foreseeable future.

For instance, the following rough calculation can be made to assess possibility of the full cost recovery for the proposed M/P project in the seven Governorates. The total capital cost of the M/P project is estimated at SP 3.3 billion. (See **Chapter 10**) With the average projected population living in these areas during the project life being approximately 420,000, the estimated capital cost per household is SP 43,000, assuming the average household size of 5.5 persons (Census 2004). The total average forecast annual M/P project-related O&M costs are approximately SP 55 million, excluding price contingency, which is 720 SP/household/year. Therefore, assuming the capital cost recovery period of say 20 years, the annual full cost per household would be approximately SP 2,870 (SP 43,000 / 20 years + SP 720).

On the other hand, an average household theoretically has to pay for sewerage services according to the current tariff table only SP 153 per year, calculated as SP 120 at the fixed annual fee plus the estimated average SP 33 as a volume-based fee (110 LCD / 1000 × 365 days × 5.5 persons × 5% × 3 SP). This means that in order to ensure the full cost recovery of the M/P project, the current tariffs should be raised almost 19 times upfront (SP 2,870 / SP 153), excluding inflation and other sewerage costs that were ignored for the particular M/P project. Furthermore, this figure does not take into account the capital costs to be incurred for partial replacement of equipment during these 20 years, nor the associated financial cost. Such a drastic increase of tariffs compared to the existing tariff table, (not to mention the fact that even this tariff table is not applied in the M/P areas yet) is not viable. See also an affordability analysis in **11.3.3** below.

Therefore, in preparation for the financial plan, it was assumed that all capital costs of the project would be eventually contributed as subsidy. On the contrary, following the best international practice and policy of the Government of Syria, at least the O&M costs of the sewerage system upon the project completion should be financed from the revenue generated, i.e. from the sewerage fees. Accordingly, the recovery of the O&M costs is indispensable to the assessment of the project financial viability.

It should be noted that no efforts were made to justify the overall financial viability of a fragmented M/P investment, nor any of its components, by using the Financial Internal Rate of Return (FIRR) as a criteria. By definition, the FIRR does not exist (i.e. the result is negative) if capital costs are not fully recovered. However, a hypothetical scenario wherein the sewerage tariffs are raised for the project to become financially feasible (FIRR > 10%) is described in detail in the F/S Report, based on more specific financial data and affordability analysis for the Zabadani area. Refer to Chapter 7 of the F/S Report for the FIRR calculation.

11.3.2 O&M Cost Recovery

The 10th Five-Year Plan requires the gradual increase of recovery of the cost of sewage

collection and treatment from 25% in 2006 to 50% in 2010. Even though no reliable accounting data is available on this matter, it can be assumed that the current recovery of the O&M costs is about 50%, which is also confirmed by the management of Damascus STP. It was assumed, therefore, that 100% recovery of the O&M cost through user charges should be achieved, for the project to be financially sound. The 100% recovery of the O&M cost, assumed in the financial plan, would represent a very important, but at the same time, attainable target for financial sustainability of the sewerage system throughout the project life.

The following table shows the average forecast project-related unit O&M costs (per one m^3 of the treated wastewater) for each of the seven M/P priority areas. It must be pointed out that these represent only those costs that are relevant to the M/P project under consideration, i.e. excluding those O&M costs that do not relate to the M/P project. The costs were calculated as the average for the years 2014 to 2025 in constant 2008 prices, i.e. excluding the effect of inflation.

Table 11.3.1 Unit O&M Costs in the M/P Priority Areas

M/P Priority Area	Average O&M cost per one m^3 of wastewater (SP, in constant prices)
Lattakia	4.8
Tartous	2.2
Deir-Ez-zor	1.7
Hassakeh	2.5
Raqqa	1.0
Dar'aa	1.9
Rural Damascus	2.6
M/P Average	**2.0**

It follows from the above table, the forecast M/P project-related unit O&M cots of the seven M/P priority areas range from approximately 1 SP/m^3 of the treated wastewater in Raqqa to more than 5 SP/m^3 in Lattakia, with the rest being approximately 2 SP/m^3 (in constant, i.e. not-inflated, prices). The forecast O&M costs can be compared to the O&M costs estimated by the management of the already functioning sewage treatment plants: 3.7 SP/m^3 in Damascus STP and 3.5 SP/m^3 in the STPs located in Aleppo and Homs. The differences amongst the forecast unit O&M costs from one priority area to another can be explained by the adopted technology, as well as by the scale of the system and by other circumstances. For instance, the highest unit O&M cost is projected for the smallest system in Lattakia.

11.3.3 Outline of the Financial Plan of Sewerage Projects

As explained above, the financial plan for the M/P sewerage projects assumes that all capital costs will be eventually contributed to the sewerage O&M entity by the state budget, either from the Public Debt Fund, or through a loan taken on the international financial markets and repaid

from the general revenue of the state budget, or by using other grant funds. Accordingly, repayment of the funds to finance the capital cost was excluded from the financial plan.

At the same time, sound financial management of the M/P sewerage project requires that the revenue generated by the project (sewerage charges) should at least cover all O&M costs of the project.

The required sewerage charges can be roughly estimated using the following calculation. Let us take the average O&M costs upon M/P sewerage project completion as approximately 2 SP/m^3, ignoring the O&M costs that are irrelevant to the M/P project. Assuming the daily average water consumption of 110 LCD and the country-average household size of 5.5 persons (Census 2004 results), the monthly water consumption by an average household accounts for approximately 18 m^3 (110 LCD / 1000 × 30 days × 5.5 persons). Therefore, for the sewerage system to operate at the breakeven, the collected average monthly sewerage charges should be approximately SP 36/household (18 m^3 × 2 SP), i.e. approximately 7.2 USD. Since SP 10/month are assumed to be paid by domestic customers as fixed fee (1/12th of 120 SP/year), the variable sewerage fee should be approximately 1.44 SP/m^3 (excluding inflation and fixed fees). Therefore, in order to achieve the 100% recovery of the O&M costs of the proposed M/P sewerage system, if the existing system of charging sewerage fees as a percentage of water fees is continued in the future and if for instance the current water tariff remains at 3 SP/m^3, the required average additional percentage charged for the sanitation services could be estimated as about 50% (1.44 / 3), in addition to 120 SP a year paid as a fixed fee.

To a limited extent, cross subsidies from the water supply revenue can be used for subsidizing the sewerage system, but only in the distant future, because the water supply system itself needs to be subsidized.

Whereas an affordability analysis will be made at the Feasibility Study stage based on a more accurate estimation of the capital and O&M costs, as well as on the results of a public survey, a preliminary assessment of affordability for the M/P priority areas can be made. At first glance, even the full cost recovery for the proposed M/P sewerage projects appears to be affordable. Indeed, using the figures provided in the Report on the Project for Development of New Water Sources for Damascus City in the Syrian Arab Republic (JICA, March 2005) as guidelines, it could be assumed that the average household income is approximately SP 10,000 (unfortunately, the figures provided in this Report are not reliable due to the sampling method that was adopted, but no better statistics on the household income was found). Therefore, the above-mentioned full sewerage cost of SP 2,200 per year, i.e. approximately SP 180 per month per one household, would account for approximately 2% of the average household income. This seems affordable for the average household, considering the 4% - 5% threshold usually taken by international donor agencies for water and sewerage charges altogether. However, it should be pointed out

that nominally, the affordability of the combined water and sewerage tariff should be considered, and not the sewerage tariff alone, especially since the sewerage part of this combined tariff is less significant.

Currently, the policy of the Government of Syria is to gradually achieve the 100% recovery of the O&M costs both for the water supply and for sewerage. Following this policy, the sewerage tariffs are recommended to ensure at least 100% recovery of the O&M costs, which seems to be affordable. Thus, adding together 2 SP/m^3 for sewerage and the roughly estimated 15 SP/m^3 for water supply and assuming that both systems should operate at break-even in terms of the O&M cost recovery, the average household water & sewerage charges will amount to approximately SP 300 (17 SP/m^3 × 18 m^3) in constant prices (excluding inflation), which accounts for 3% of the average household income. It is still less than the 4% - 5% threshold. Therefore, the proposed recovery of the O&M sewerage costs through user charges should theoretically be affordable for most of the Syrian households, subject to the condition that a social safety net is in place. Moreover, even a partial recovery of the capital costs (for instance, recovery of 50% of the capital costs or recovery of the costs of electrical and mechanical equipment as suggested by GTZ) could be considered in a more distant future.

A further elaboration on the country's average sewerage charges is premature at this time, due to the significant and variable differences across the country and the lack of reliable volumetric information split by different user groups, corresponding to the lines of the recently revised water & sewerage tariff table. Efforts will be made, however, to re-confirm the above calculation for the Rural Damascus priority area during the Feasibility Study stage. Refer to the Chapter 7.2.4(2) in F/S report.

11.3.4 Findings from the Financial Plan

Based on the above provided outline of the financial plan for the M/P sewerage projects, the following conclusions can be drawn:

- The project capital costs are assumed to be granted to the respective establishments by the Government of Syria or other donors;
- Recovery of the sewerage O&M costs through sewerage charges is recommended to ensure financial sustainability of the project throughout the future;
- In order to achieve the 100% recovery of the O&M costs upon project completion, it was estimated that the average sewerage charges should account for at least 1.44 SP/m^3 (excluding inflation and fixed fees), i.e. about 50% of the existing lowest-tier water tariff;
- Sewerage tariffs should be regularly adjusted for inflation;
- Regionalization of sewerage tariffs is advisable due to different conditions for the

O&M;

- The use of cross subsidies from the water supply revenue to the sewerage system could be considered in the future.

CHAPTER 12 FORMULATION OF SEWERAGE DATABASE FOR SMALL CITIES AND RURAL AREAS

The utilization of the Geographical Information System (GIS) is effective in data collection, storage and management. The GIS system is a computer tool that can aid in policy formulation, decision-making and information management for the development and operations of sewerage systems. In this project, the formulated GIS system consists of graphical data, which includes information on existing sewerage facilities and networks such as trunk sewers, pumping stations, water sources and industrial plans.

The MHC has not yet prepared any database for the facilities of sewerage system, water supply and water environment. Therefore, the water pollution control programs and the operation and maintenance of sewerage systems have not been conducted by using GIS effectively due to lack of data on locations, alignment and other information on these facilities.

12.1 Existing GIS in Syria

The list of organizations that presently use the GIS is shown in the **Table 12.1.1**. There is no cooperation or sharing of the information among these organizations.

Table 12.1.1 List of Organizations Using GIS tool

Organization	Condition
Regional Planning Sector, MHC	This sector has basic digital maps of seven (7) governorates. Notably, the organization plans have been held by only this sector.
Directorate of Information and System, Ministry of Local Administration and Environmental Affairs	This directorate has been implementing the project, "Comprehensive Disaster Reduction Programme". In this project, "Geomedia" has been utilized as GIS software."
Water Resource Information Center (WRIC)	WRIC implemented the project, "Water Resources Management Barada/Awaj Basin & Coastal Basin". The center formulated the GIS database in Barada basin, Awaj basin and coast area basin.
General Organization of Remote Sensing (GORS)	GORS has been conducting several projects relevant to the GIS database at the request of the other organizations. The Study Team obtained the GIS database in Tartous and Lattakia from the GORS.
Damascus Water Supply & Sewerage Authority (DAWSSA)	DAWSSA has the basic digital map of Damascus City and formulates GIS database for water supply and sewerage system facilities.
General Establishment System (GES)	GES created the basic digital map of the whole of Syria with 1: 50,000 scales.

12.2 Formulation of Sewerage Database for Small City and Rural Area

12.2.1 Selection of GIS Software and Procurement Plan

After assessing GIS software available in Syria, "ArcGIS" and "Geomedia" have been utilized as GIS tools in several organizations. At present, the purchase of GIS software is difficult due to the economic sanctions imposed by the United States government. However, according to

the current survey, the distributors of GIS software in Syria have purchased large quantities of licensed software, having obtained these prior to the enforcement of US sanctions.

Thus, the Study Team decided to utilize the "ArcGIS" as the GIS tool to aid this study, considering the factors of operational performance, condition of distributors for GIS software, status of utilization of GIS software in each organization, trends in the utilization of GIS software in the future, and formats of the obtained basic digital map data. The comparative result of GIS software is shown in the **Table 12.2.1**.

Table 12.2.1 Comparison of GIS software

Items	ArcGIS	Geomedia
Distributor of GIS software	ESRI	Intergraph
Operational Performance for GIS software	This is simple file management application that creates figures and attributes. It is possible to understand basic operation after acquisition of approach for the new preparation of shape files and modifications.	Figures and its attribute data are managed by MS-Access and Oracle etc. It is possible to understand basic operation after acquisition of the operation in workspace.
Evaluation	○	○
Status of Distributor for GIS software in Syria	Distributor in Syria: HI-TECH HOUSE HI-TECH HOUSE is registered as an agency by ESRI. It is impossible to purchase the latest version of ArcGIS due to the economic sanction of United States. In this regard, it is still possible to purchase "ArcGIS 8.3" in a legal way.	Distributor in Syria: Modern & Technologies Modern & Technologies is not an agency of Intergraph, but a branch of Dubai agency. However, according to Intergraph Japan, Modern & Technologies has not been confirmed as an agency. Furthermore, it has been clear that the approval from Intergraph would not be issued at the time of purchase.
Evaluation	○	×
License Control for GIS Software	It is necessary to put a dongle key to the computer for starting ArcGIS. Therefore, it is possible to prevent the usage of the illegally-copied program.	Geomedia does not have a hardware key such as a dongle key for starting. Therefore, the illegally-copied program can appear but the management of the data may be inadequate due to the absence of a license..
Evaluation	○	×
Status of use of software for GIS in each ministry or department	The Study Team confirmed the usage of ArcView by several organizations listed below. • Regional Planning Sector, MHC • GES • GORS • DAWSSA • WRIC	Decision Support Center in the Ministry of Local Administration and Environment is using Geomedia.
Evaluation	○	△
Trend for utilization of GIS software in the future	The organizations which use ArcGIS now will not change their GIS software in the future. Furthermore, the Ministry of Urban Planning is planning to shift to ArcGIS from Geomedia	Decision Support Center will not change GIS software in the future.
Evaluation	◯	△
Format of the basic digital map	The format of the basic digital map made by GES is a shape file. This means that the shape file is made by ArcGIS.	
Evaluation	◯	△
Overall	12 points	5 points

Table 12.2.1 Comparison of GIS software

Items	ArcGIS	Geomedia
Evaluation		

Note) ○:2 points, △:1 point, ×: 0 point

Based on the initial plan for Geomedia in the preliminary survey, the JICA Study Team has conceived a new procurement plan for ArcGIS. The specification of ArcGIS assumes that it is same as that in the initial plan. The new procurement plan is shown in **Table 12.2.2**.

Table 12.2.2 New Procurement Plan of GIS software

Initial Procurement Plan	New Procurement Plan
Geomedia Professional: seven (7) licenses Geomedia PublicWorks: one (1) license	Arc View: seven (7) licenses Arc Editor: one (1) license

12.2.2 Selection of Basic Digital Map

Firstly, the formulated data in the project entitled, "Comprehensive Disaster Reduction Programme" was meant to be used as the basic digital map in this Study. The contents of the above programme are shown in **Table 12.2.3**.

Table 12.2.3 Contents of Formulated Data in "Comprehensive Disaster Reduction Programme"

Items	Contents
Target area	All over Syria
The categories of data	(1) Administrative boundary (2) Urban planning (3) Land use, Topography, Geography, Vegetation (4) Temperature, Rainfall (5) Ruin (6) Hospital (7) Road (8) Served area for sewerage
Using GIS software	Intergraph, Geomedia

The data for the basic digital map ((1), (3), (7)) was provided by the regional planning sector in MHC. However, information on other items ((2), (4)~(6), (8)) and the actual points are not shown by longitude and latitude, because the point data is placed at the center of each boundary. Therefore, it is difficult to utilize this information on the GIS database which the JICA Study Team has formulated in this project.

12.2.3 Formulation Work of Sewerage Database for Small City and Rural Area

The JICA Study Team conducted the formulation work of the sewerage database for small cities

and rural areas under a sub-contract. This work consists of the collection of the position data and attribute data regarding sewerage facilities, water resources and water pollution sources, and a combination of graphical data which describes object geometry (for example sewer lines), and numerical data which relates to graphical data (for example diameter of sewer pipelines).

(1) Target Facilities and its Attribute Data

Based on the basic digital map obtained from the regional planning sector in MHC, the sewerage database was formulated by the field survey in the seven governorates. The field survey consists of interviews with operators in each facility and the measurement of the position data by the use of GPS (GPS: Global Positioning System). The target facilities and collected information on their attributes for the sewerage database are shown in the **Table 12.2.4**.
The target facilities were selected on the basis of discussions with C/P as cited below:

- Main facilities of the sewerage system; Sewerage treatment plant, Pumping station and Trunk sewer

This information will be utilized for the operation and maintenance of the facilities and future planning for the sewerage system. Therefore, such information should be collected as a priority.

- Pollutant sources that affect water quality in public water bodies; livestock and industrial plant

This information will be utilized for establishment of the effluent standard and management of water discharge effluent.

- Water source for water supply system that is affected by water pollution; rivers, wells and springs

This information will be utilized in considering the site locations of the water intake and water discharge points from the STP and the pollutant sources.

Table 12.2.4 Target Facilities and its Attribute for Sewerage Database

Survey Items			Unit	Data format
1-1. Intake point	(1)	Coordinate data	-	° ' "N ° ' "E
	(2)	Name of location	-	
	(3)	Intake method	-	1:□ Surface water 2:□ Groundwater 3:□ Spring 4:□ Others (_____)

Table 12.2.4 Target Facilities and its Attribute for Sewerage Database

Survey Items			Unit	Data format
	(4)	Amount of water intake	m^3/day	Design: m^3/day Actual: m^3/day
2-1. Industrial Plant	(1)	Coordinate data	-	° ' " N ° ' " E
	(2)	Name of plant	-	
	(3)	Industry sector	-	1: □ Olive 2: □ Food 3: □ Chemical 4: □ Construction Materials 5: □ Fiber 6: □ Others( )
	(4)	Industrial pretreatment facility	m^3/day	Design: m^3/day Actual: m^3/day
	(5)	Effluent volume	m^3/day	Design: m^3/day Actual: m^3/day
	(6)	Effluent water quality	mg/L	BOD (If it is measured) mg/L
	(7)	Coordinate data for location of discharge	-	° ' " N ° ' " E 1: □ Drainage or River (Name:) 2: □ Sewer 3: □ Utilization for irrigation 4: □ Others ( ) 5: □ Non discharge 6: □ Unknown
2-2. Livestock	(1)	Coordinate data		° ' " N ° ' " E
	(2)	Name of Location	-	
	(3)	Species of livestock	-	1: □ Sheep 2: □ Cow 3: □ Others ( )
	(4)	Number of heads	No	
	(5)	Location of discharge	-	° ' " N ° ' " E 1: □ Drainage or River (Name:) 2: □ Sewer 3: □ Utilization for irrigation 4: □ Others ( ) 5: □ Non discharge 6: □ Unknown
3-1. Sewer	(1)	Name of Location	-	
	(2)	Catchments area	m^2	
	(3)	Served population	People	
	(4)	Length	m	
	(5)	Diameter	mm	
	(6)	Construction year	Year	
	(7)	Record of cleaning and repairing for sewer	-	
4-1. Sewage treatment plant (s):	(1)	Coordinate data	-	° ' " N ° ' " E

Table 12.2.4 Target Facilities and its Attribute for Sewerage Database

Survey Items			Unit	Data format
STP	(2)	Name of STP	-	
	(3)	Site area	m^2	
	(4)	Treatment Method	-	1:□ Activated Sludge 2:□ Extended Aeration 3:□ Wet Land 4:□ Oxidation Ditch 5:□ Lagoon 6:□ Others
	(5)	Capacity	Year	Design: m^3/day Actual: m^3/day
	(6)	Served Population	People	
	(7)	Construction year	Year	
	(8)	Record of repairing	Year	
		<Drawings>		
	(1)	Location map	-	
	(2)	Ground plan	-	
4-2. Pumping Station (s): PS	(1)	Coordinate data	-	° ' " N ° ' " E
	(2)	Name of pumps	-	
	(3)	No. of pumps	no.	Design: . Actual: .
	(4)	Capacity	Year	Design: m^3/day Actual: m^3/day
	(5)	Construction year	Year	
	(6)	Record of repairing	Year	
		<Drawings>		
	(1)	Location map	-	
	(2)	Ground plan	-	

(2) Number of Target Facilities for Field Survey

It is impossible to collect all the required information in the course of the field survey due to the huge number of target facilities in the seven governorates. Therefore, the process taken in determining the number of target facilities is described below.

- At least 15 locations shall be investigated in each governorate. In Rural Damascus governorate, the number of target facilities should be increased because there are many industrial plants located in this area compared to the other governorates.
- The features of the trunk sewers shall be digitized by using collected high accuracy drawings.
- The selection of the target facilities will be decided by comparing the recommended facilities for each governorate with the selection done by the JICA Study Team.

(3) Selection of Projection for the Map Data

In Syria, the STM (Syria Transverse Mercator projection) has been utilized in the projection. However, this information has not been published in general due to military rules and the

sensitive nature of the data. Therefore, in this project, "GCS_WGS_84" and "WGS_1984_UTM_Zone_37N" shall be applied to projection of GIS map data.

12.2.4 Result of the Formulated Sewerage Database

(1) Structure of Folder

The structure of the folder for the shape files is shown in **Table 12.2.5**. This structure is followed in the preparation of databases for each governorate.

Table 12.2.5 Structure of Folder for Shape Files

Main Folder Name	Sub Folder Name	Layer Name
BASEMAP	MAP	These layers have been defined by GES.
	ADDITION	ORGAN_PLAN
		BOUND_VILLAGE
SW_DATABASE	WR	WR
		WPS_I
		WPS_L
	SF	SEWER
		STP
		PS

(2) The Contents of Attribute Data

The contents of the attribute data are shown in **Table 12.2.6**. The definition of attribute data is shown in Appendix 1. Furthermore, the definition of layers for the basic digital map and the status of layers obtained from the regional planning sector in MHC are also shown in the appendix.

Table 12.2.6 Contents of Attribute Data

No	Map (Layer) Name	Type	Data Content	Main Attribute Data
1	ORGAN_PLAN	Polygon	The polygon for organization plan	id, name, Pop, Remark
2	BOUND_VILLAGE	Polygon	Boundary for village or small city	id, name, Pop, Remark
3	WR	Point	The points for water resources	id, LAT_DEG, LAT_MIN, LAT_SEC, LON_DEG, LON_MIN, LON_SEC, Name, I_Method, Amount_D, Amount_A, Remark
4	WPS_I	Point	The points for industrial plants	id, LAT_DEG, LAT_MIN, LAT_SEC, LON_DEG, LON_MIN, LON_SEC, Name, I_Sector, Capa_TD, Capa_TA, Dis_D, Dis_A, Dis_LAT_DEG, Dis_LAT_MIN, Dis_LAT_SEC, Dis_LON_DEG, Dis_LON_MIN, Dis_LON_SEC, WQ_BOD,

Table 12.2.6 Contents of Attribute Data

No	Map (Layer) Name	Type	Data Content	Main Attribute Data
				Type_Dis, Remark
5	WPS_L	Point	The points for livestock	id, LAT_DEG, LAT_MIN, LAT_SEC, LON_DEG, LON_MIN, LON_SEC, Name, S_Live, Num_H, DDis_LAT_DEG, Dis_LAT_MIN, Dis_LAT_SEC, Dis_LON_DEG, Dis_LON_MIN, Dis_LON_SEC, WQ_BOD, Type_Dis, Remark
6	SEWER	Polyline	Sewer line	id, Name_L, C_Area, S_Pop, Length, Diameter, C_Year, R_Year, Remark
7	STP	Point	The points for sewerage treatment plants (STPs)	id, LAT_DEG, LAT_MIN, LAT_SEC, LON_DEG, LON_MIN, LON_SEC, Name, S_Area, T_Method, Capa_D, Capa_A, S_Pop, C_Year, R_Year, Remark
8	PS	Point	The points for pumping stations (PSs)	id, LAT_DEG, LAT_MIN, LAT_SEC, LON_DEG, LON_MIN, LON_SEC, Name, Num_PD, Num_PA, Capa_D, Capa_A, C_Year, R_Year, Remark

(3) The GIS Database of Seven Governorates

The location maps for field survey in Syria and the seven governorates are shown in the following pages. Each point has attribute data in GIS database.

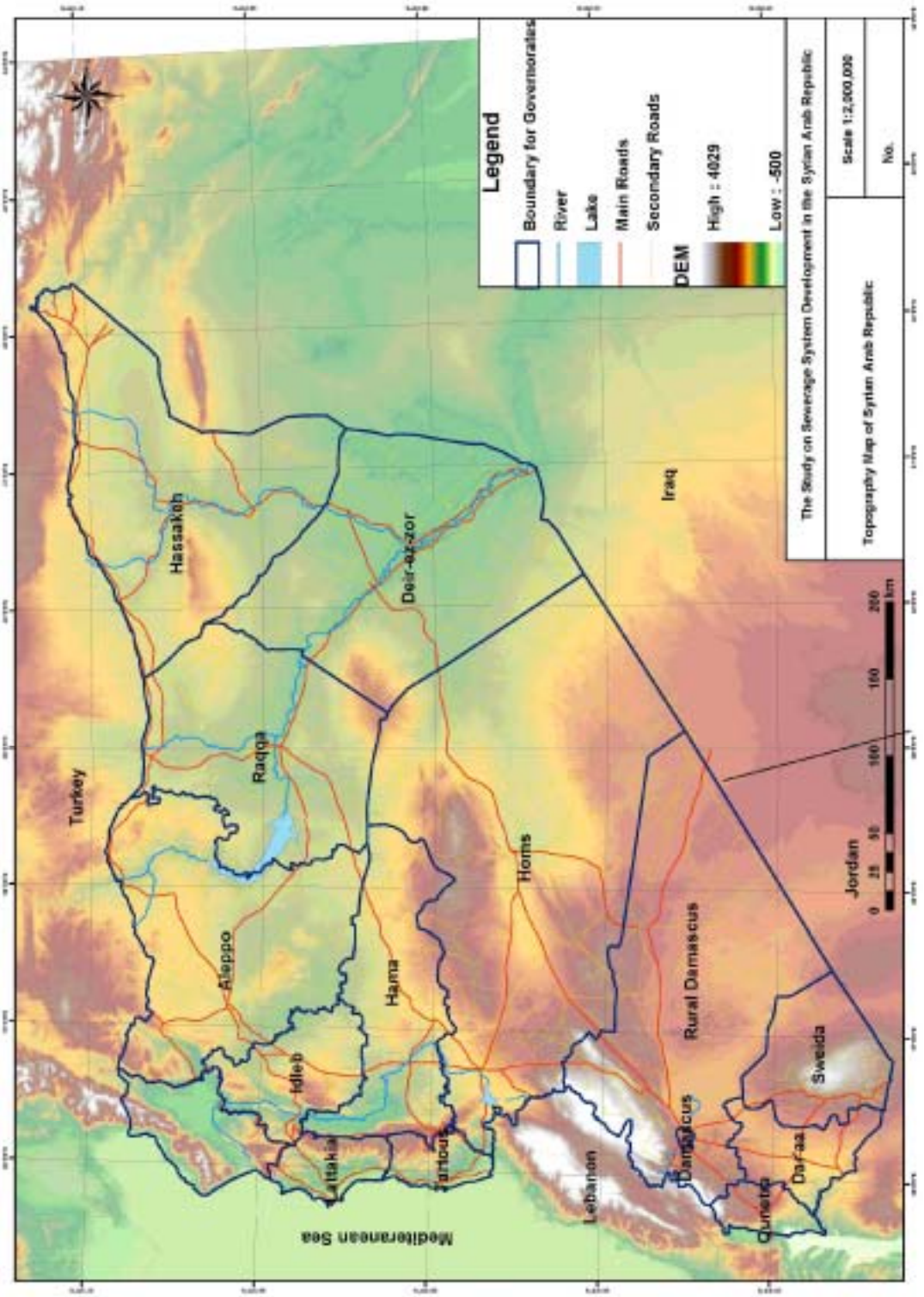

Figure 12.2.1 Topography Map of Syria

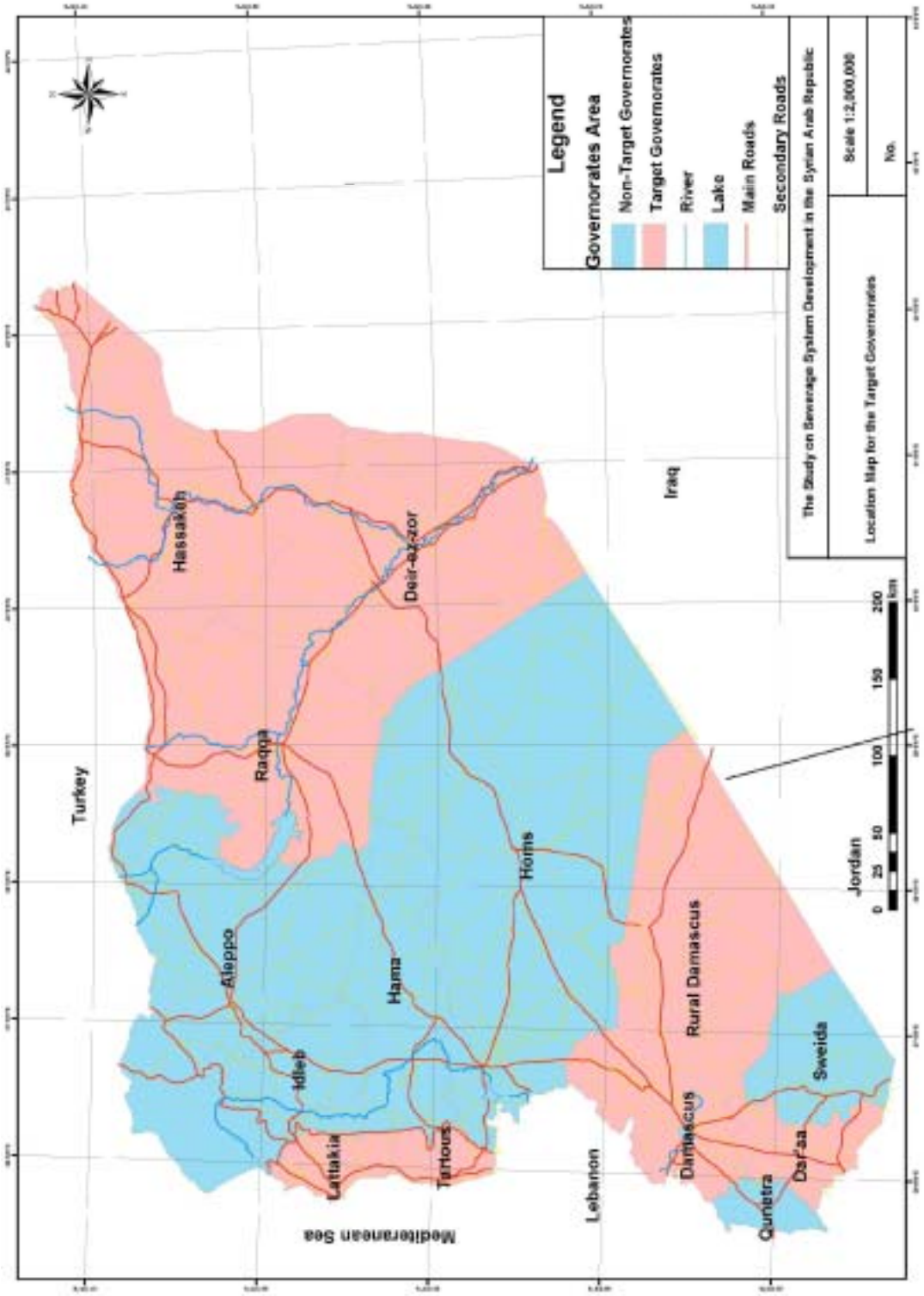

Figure 12.2.2 Location Map of The Target Governorate

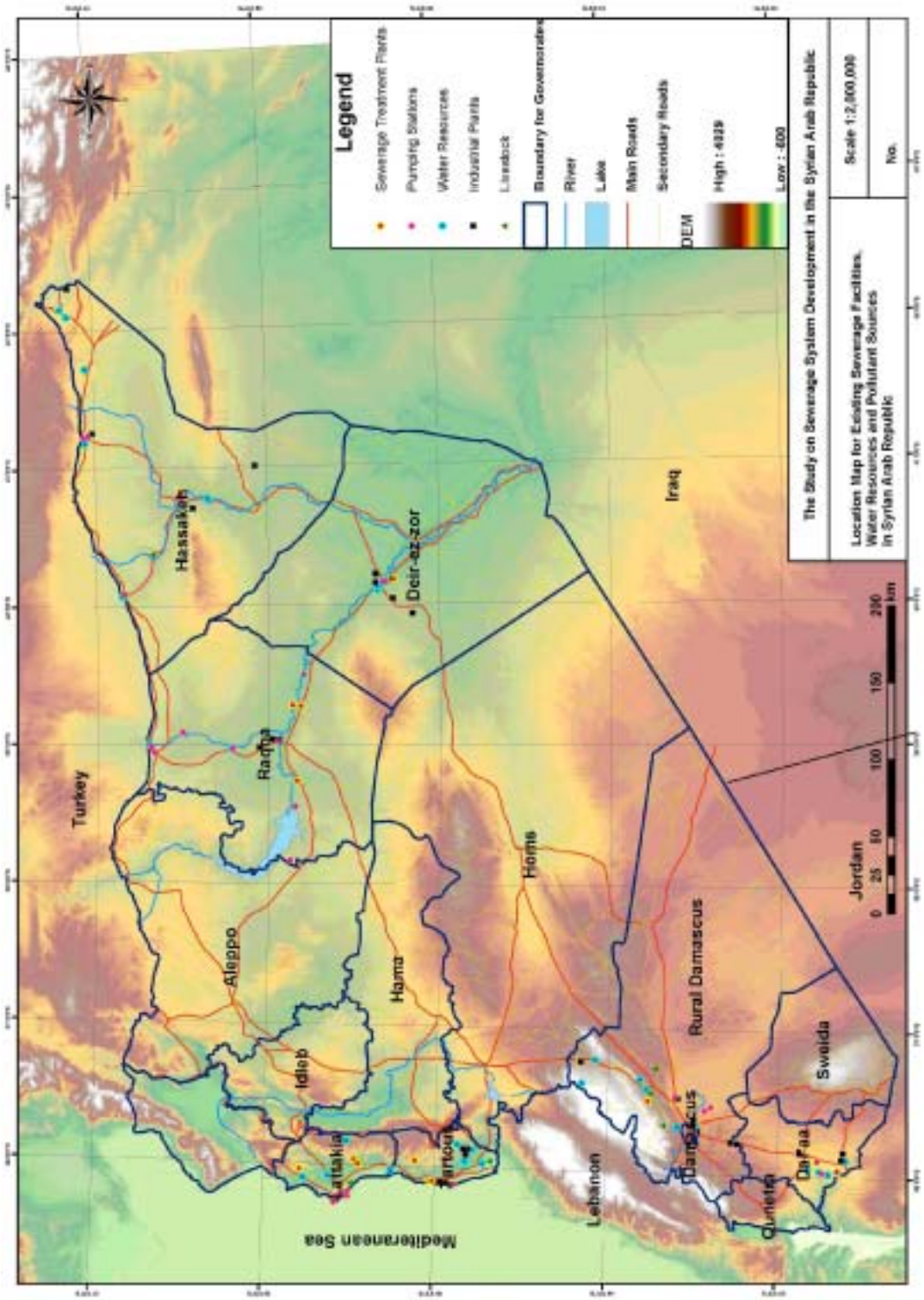

Figure 12.2.3 Location Map for Existing Sewerage Facilities in Syria

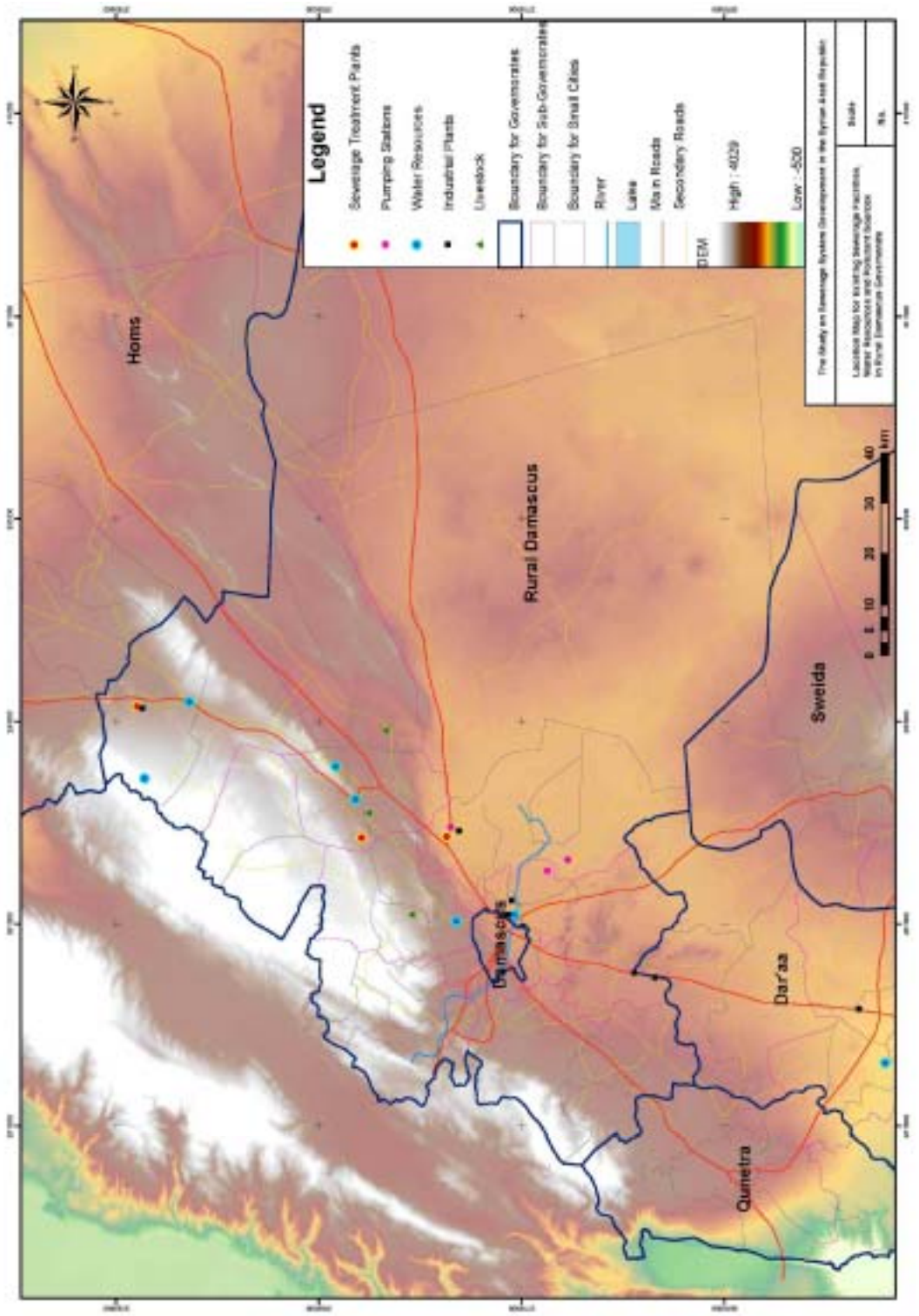

Figure 12.2.4 Location Map for Existing Sewerage Facilities in Rural Damascus

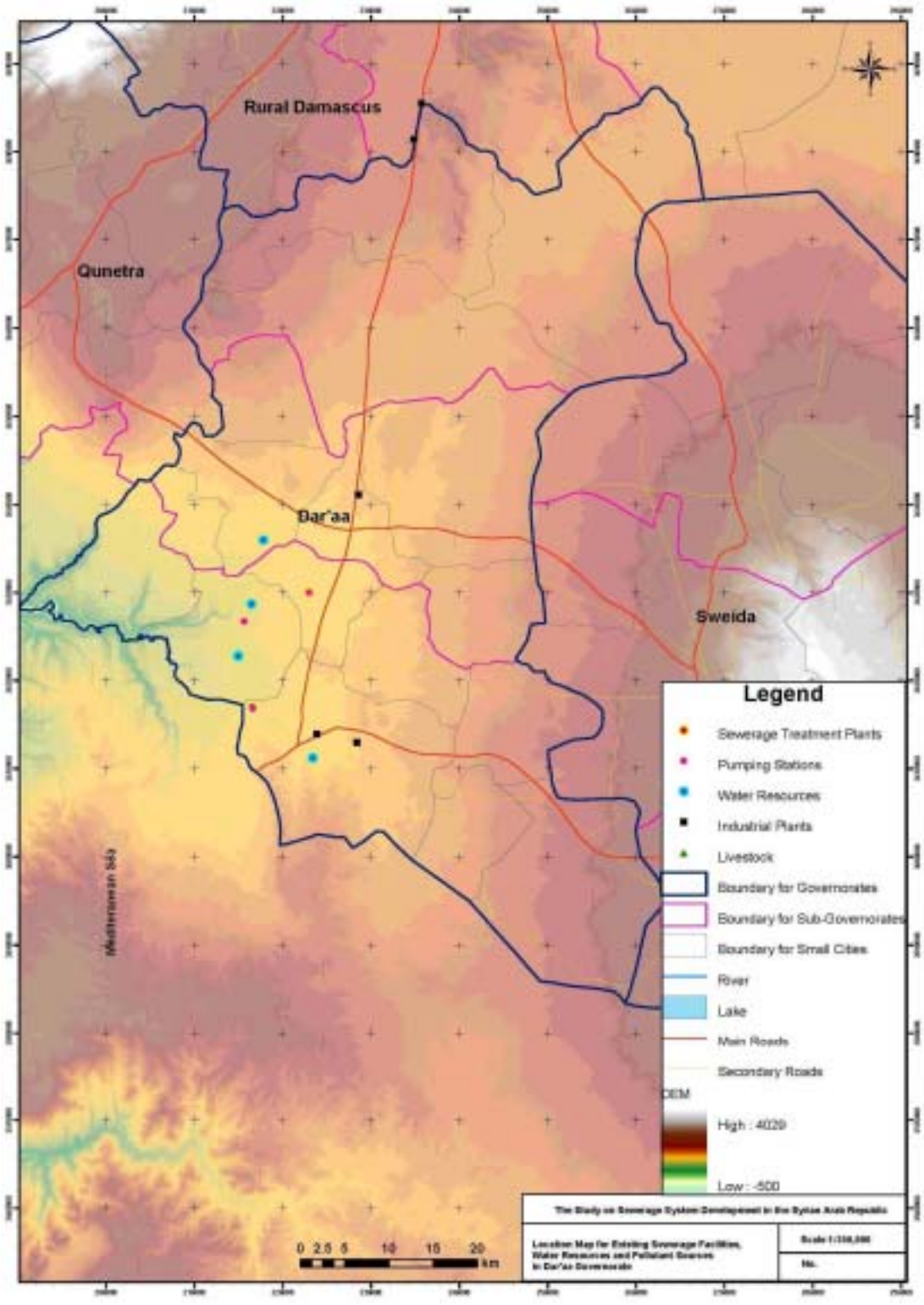

Figure 12.2.5 Location Map for Existing Sewerage Facilities in Dar'aa

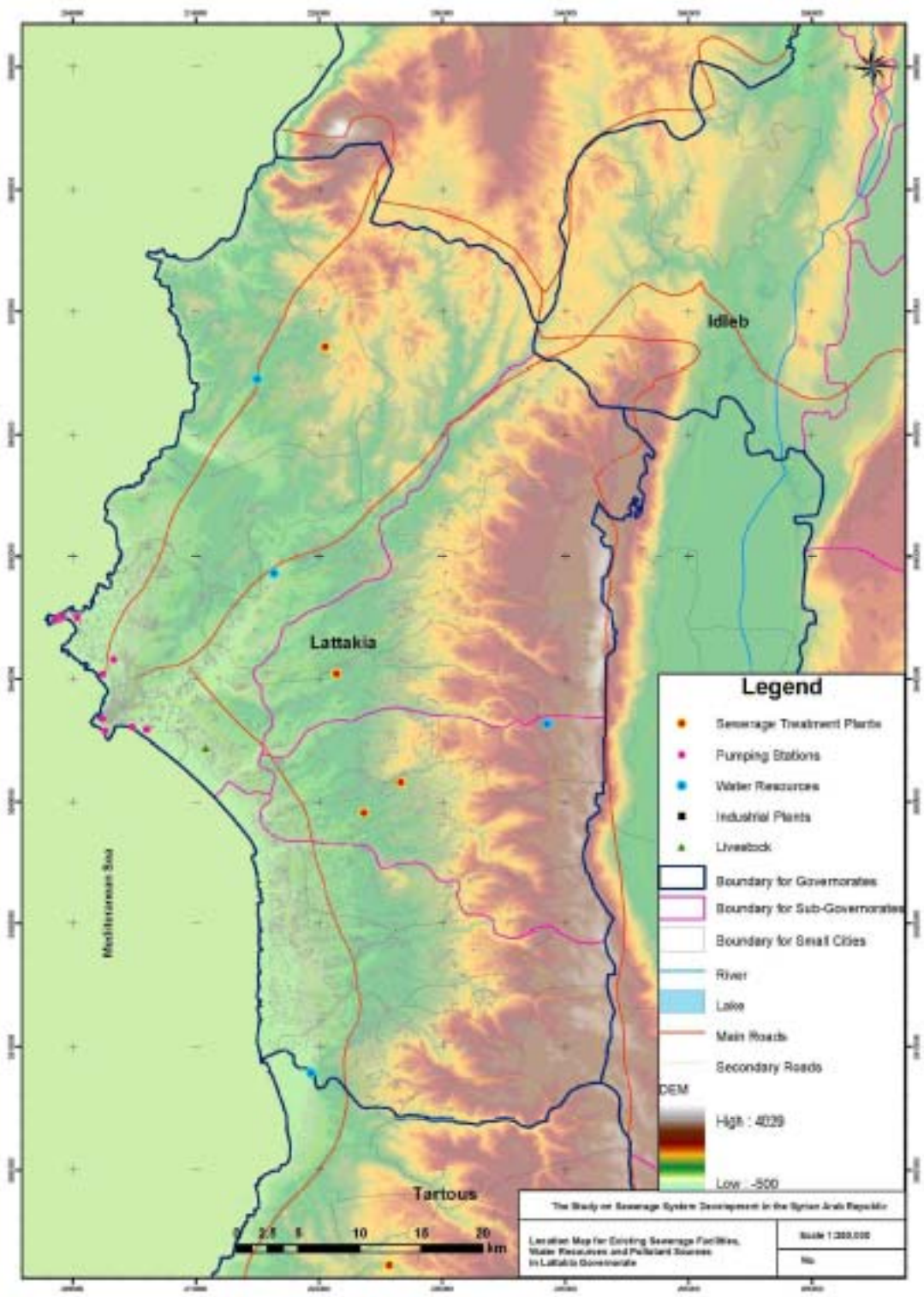

Figure 12.2.6 Location Map for Existing Sewerage Facilities in Lattakia

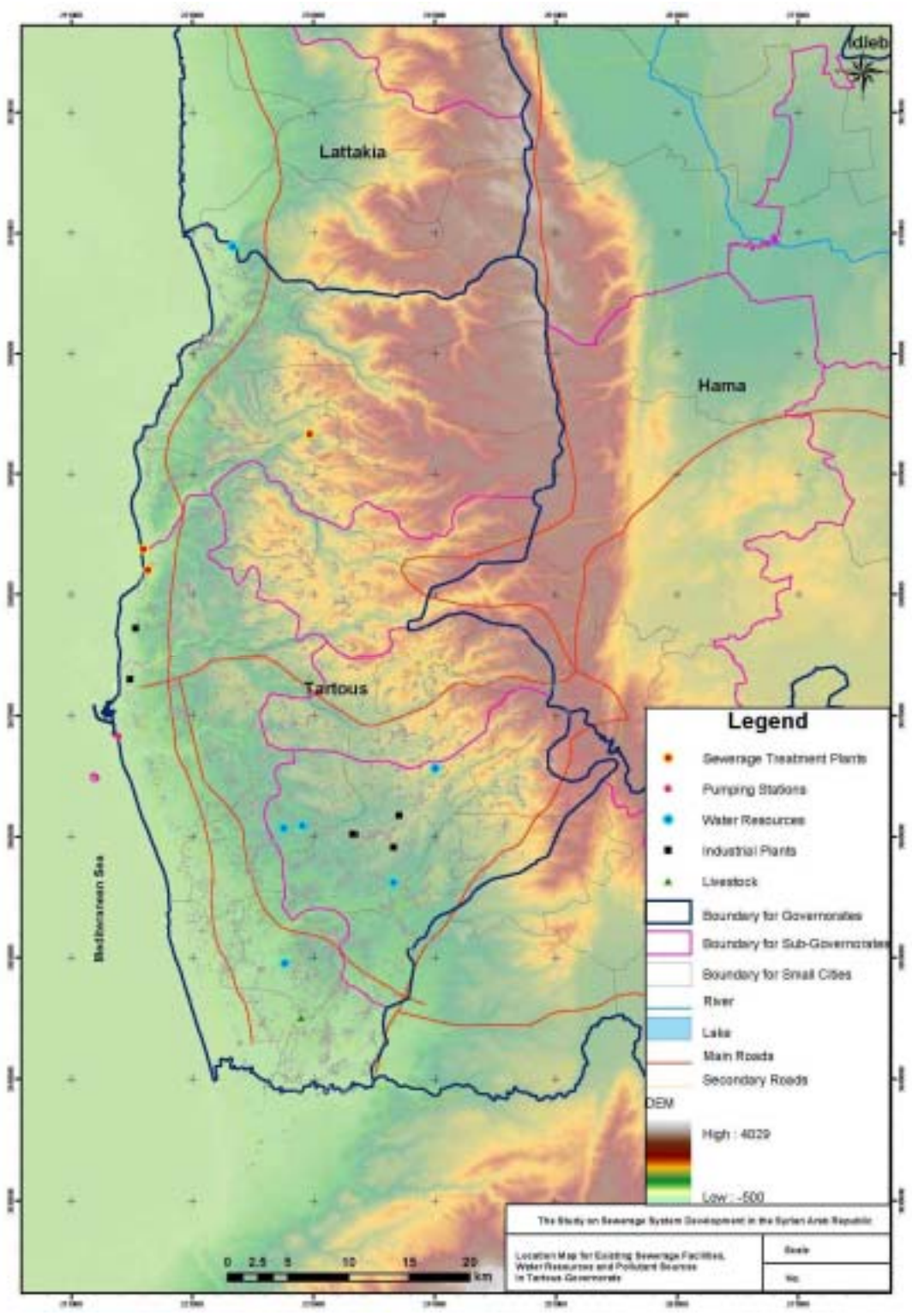

Figure 12.2.7 Location Map for Existing Sewerage Facilities in Tartous

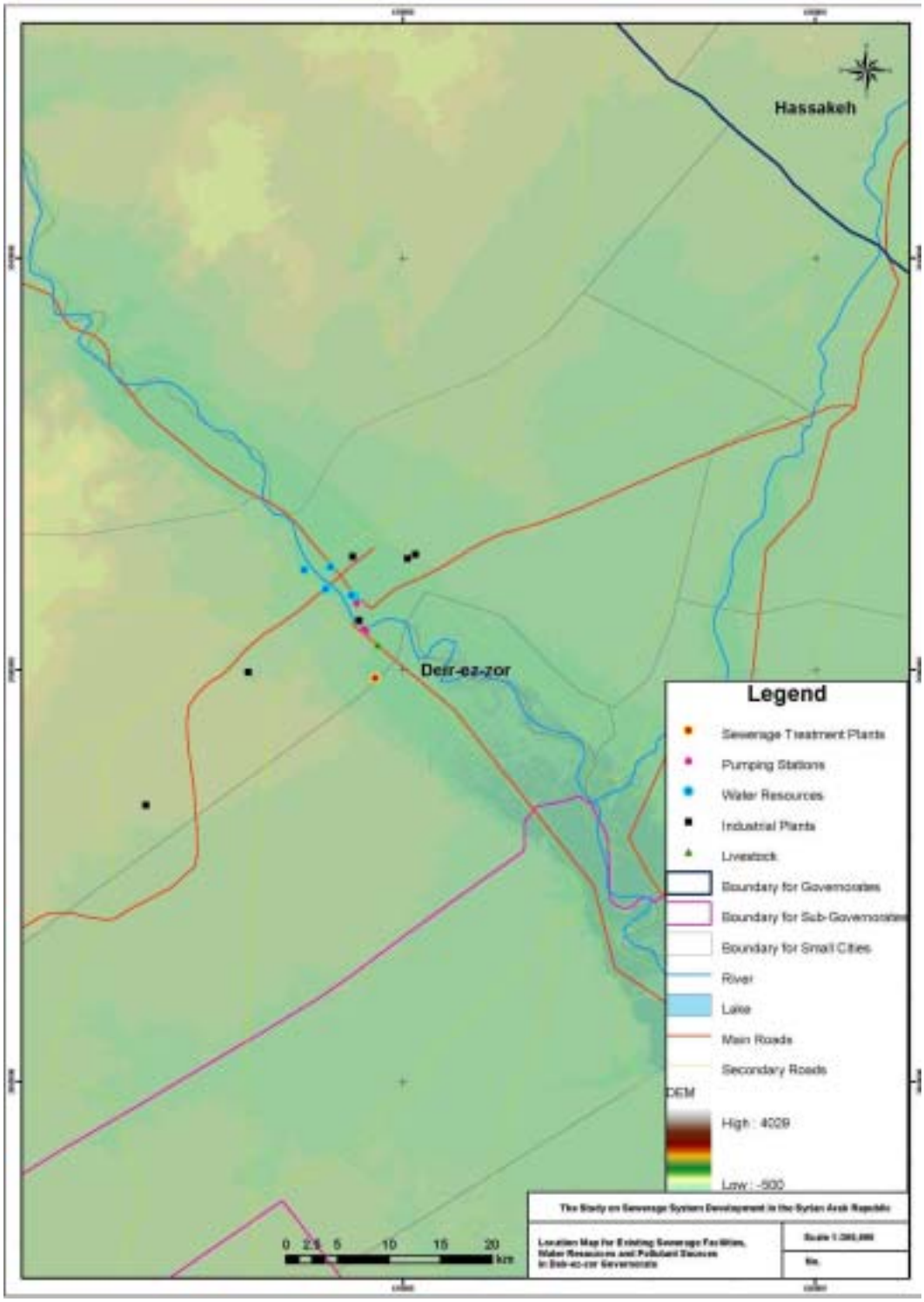

Figure 12.2.8 Location Map for Existing Sewerage Facilities in Deir-Ez-zor

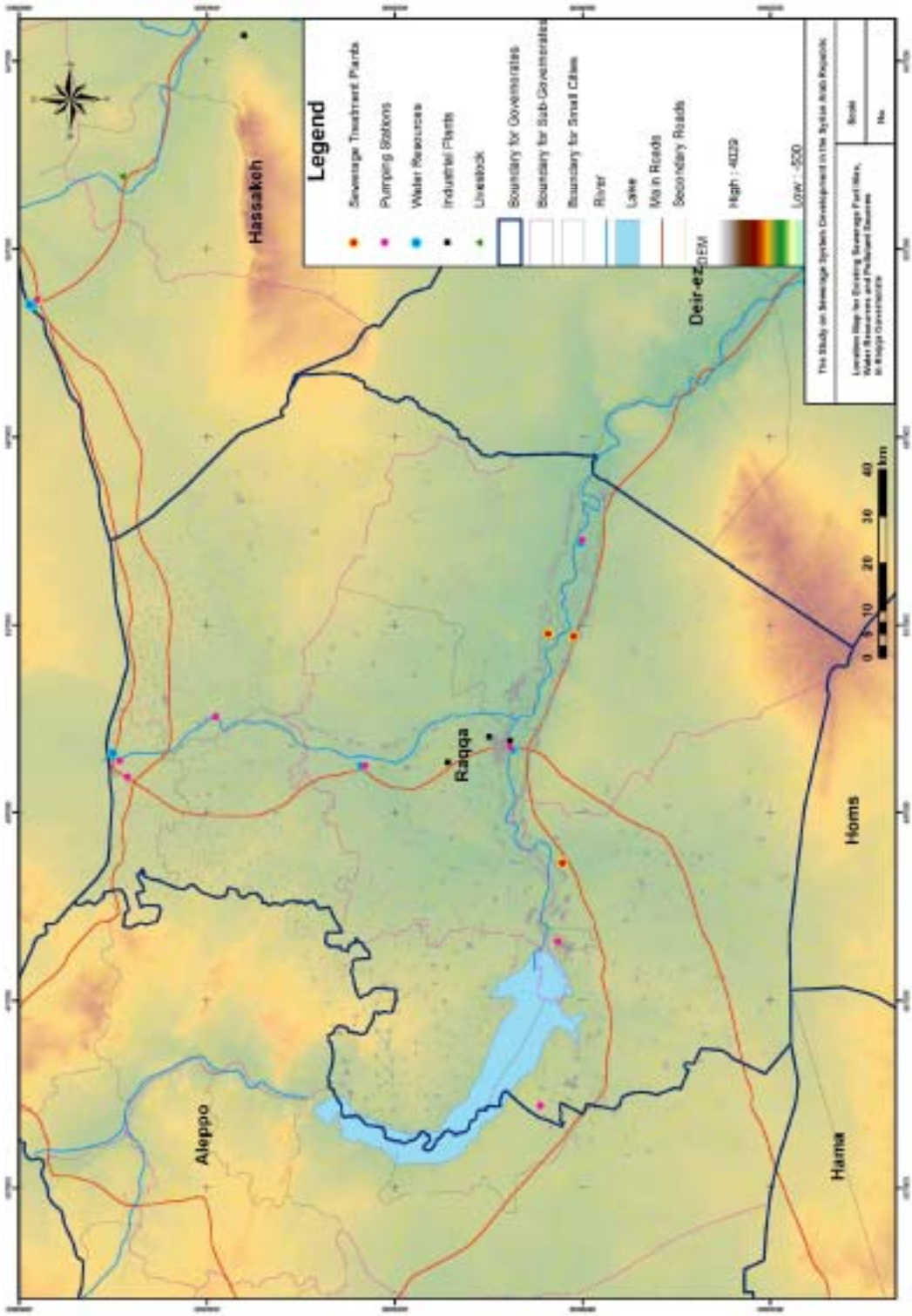

Figure 12.2.9 Location Map for Existing Sewerage Facilities in Raqqa

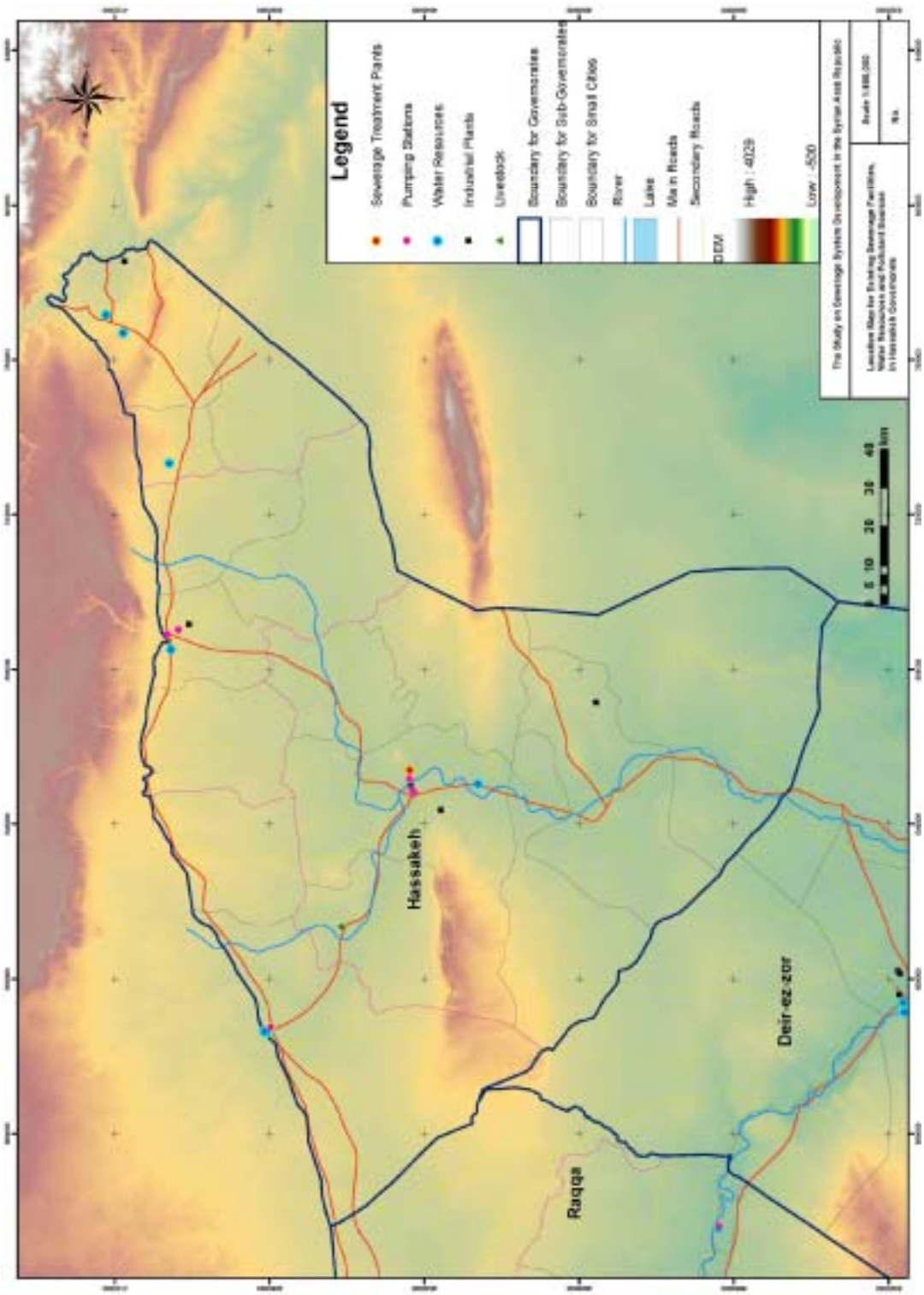

Figure 12.2.10 Location Map for Existing Sewerage Facilities in Hassakeh

12.3 GIS Training Course for Introductory Part

12.3.1 Introductory Part

According to interviews with the MHC and technical teams from the seven governorates, there is small number of GIS engineers in these organizations. Therefore, it is necessary to cite the basic operating skills needed in the formulation of the GIS database in this Study. The JICA Study Team conducted the training course on GIS in parallel with the procurement of GIS software.

The contents of the training course and its schedule are shown in **Table 12.3.1**. Participants were selected from the MHC and the seven governorates. The total number of participants was 13 and they were selected upon the recommendation of the GIS engineer. The attendees' list is shown in the appendix. Introductory seminar was conducted for 5 days.

Table 12.3.1 Contents of Training Course and its Schedule

No.	Time	Date	The contents of training
1	6 hrs	Jan. 28th	Introduction to ArcGIS (for ArcView 8, ArcEditor 8, and ArcInfo 8)
2			Exploring GIS concepts
3			Displaying data
4			Querying your database
5			Working with spatial data
6	6 hrs	Jan. 29th	Working with tables
7			Editing data
8			Working with georeferenced data
9			Presenting data
10	6 hrs	Jan. 30th	GIS review and ArcCatalog options
11			Cartography with ArcGIS
12			Displaying tabular locations
13			Customizing the interface
14	6 hrs	Jan. 31st	Designing a GIS database
15			Automating data
16			Setting geodatabase validation rules
17	6 hrs	Feb. 1st	Editing spatial and attribute data
18			Spatial adjustment
19			Spatial analysis and final project
Total	30 hrs	-	-

12.3.2 Application Part

The training course aimed to broaden the GIS engineer's understanding of the approach in the collection of spatial and attribute data, and the techniques of inputing these data into the computer. Furthermore, the course also aimed to teach participants how to configure and formulate future plans for the GIS database in the remaining seven governorates and the establishment of the GIS sector in MHC.

- Understanding of the flow chart from data collection to input data
- Formulation of the future plan by the year 2010

(1) Target Governorates

The target governorates are the seven governorates of Rural Damascus, Da'raa, Lattakia, Tartous, Raqqa, Deir-Ez-zor and Hassakeh. The training was held in three locations, that is, in Lattakia, Rural Damascus and Deir-Ez-zor.

(2) Training Method

The flow chart of the GIS training is shown in the **Figure 12.3.1**.

Flow Chart of GIS Training

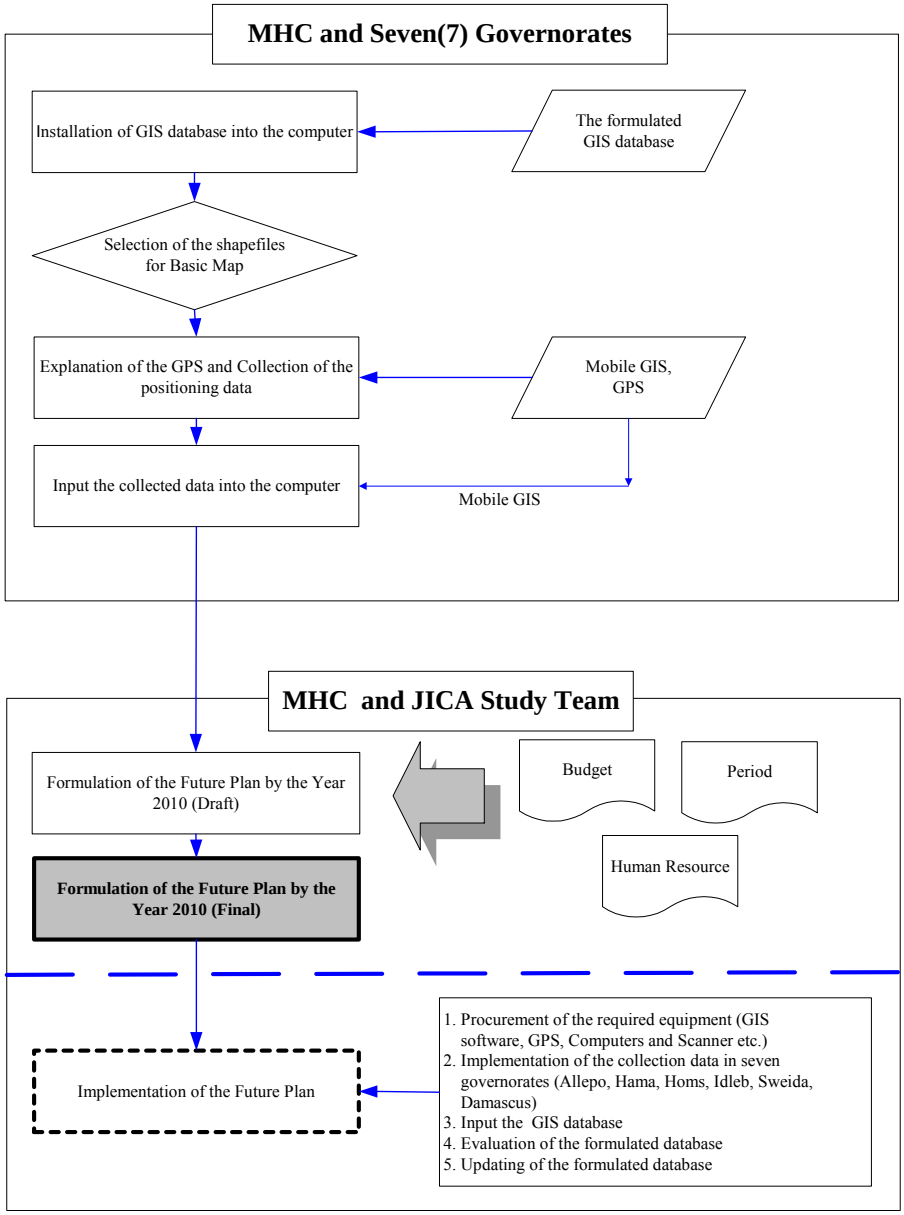

Figure 12.3.1 Flow Chart of GIS Training

- Installation of GIS database into the computer

The JICA Study Team provided the GIS database formulated in this Study to the seven governorates. The GIS database was installed in the computers at Lattakia, Deir-Ez-zor and Rural Damascus. As to the remaining four Governorates, the JICA Study Team explained GIS installation method to the designated GIS engineers during the seminar and handed them CDs with necessary data.

- Selection of the shape files

The shape file in the GIS database for the basic map was selected by MHC. The selected shape files should be adopted as the basic map in the seven governorates.

- Explanation of the GPS and collection of the positioning data

The most basic application of GPS involves the collection of (x,y) coordinates for the GIS features, Initially, these coordinates were manually entered into the GIS database. Recent GPS equipment can provide data in a GIS-compatible format, such as the ESRI Shape file format. The trainees went to visit the target facilities to collect the positioning data of the sewerage facilities in this training.

- Input of the collected data into the computer

The method of inputting the collected data into the GIS database was explained.

- Formulation of the Future Plan (Draft)

The JICA Study Team carried out the field survey and formulated the GIS database in the seven governorates in this Study. The MHC shall update its database and formulate new databases for the remaining seven governorates, Allepo, Hama, Homs, Idleb, Sweida and Damascus. Therefore, the future plan should be drawn and MHC should implement the survey based on this future plan. For the sake of applicability, it is necessary to estimate the budged allocation, human resource and implementation schedule of planned projects.

- Formulation of the Future Plan

The final future plan was made in the course of the GIS training by the JICA Study Team and MHC.

(3) Required Equipments for the GIS training

Equipment required for the GIS training are mentioned below.

Table 12.3.2 List of the Required Equipments for the GIS Training

Equipment	Quantity	Remark
GPS (Mobile GIS, GPS)	1 each	Mobile GIS is prepared by GIS company
Digital camera	1	JICA Study Team
GIS database formulated in this Study	1 each governorate, 7 in total	DVD
Arc View 8.3	1 each governorate, 7 in total	Installation of Arcview8.3 was completed.

(4) Implementation Program for the GIS training

The implementation program is shown below.

Table 12.3.3 Implementation Program of GIS Training

Date & Time	Location	Participants
18th – 19th Sep	Lattakia governorate	GIS engineers in Lattakia and Tartous
23rd – 24th Sep	Deir-Ez-zor governorate	GIS engineers in Deir-Ez-zor, Raqqa and Hassakeh
25th Sep	Rural Damascus governorate	GIS engineers in Rural Damascus and Da'raa

(5) The Result of the GIS Training

The GIS training was documented by photographs shown in the appendix.

- Understanding of the flow chart from data collection to input data

1) Participants

The participants of GIS training are shown in the appendix. These selected participants are GIS engineers from the seven Governorates and attended the previous introductory GIS training.

2) Understanding of GIS Training

The evaluation of the participants' level of understanding of GIS is shown in **Table 12.3.4**. The JICA Study Team evaluated their understanding in three items. A significant finding was that the participants' understanding of the setting of coordination systems should be strengthened by continual GIS training. Therefore, the MHC should equally plan subsequent training courses for medium grade and advanced grade GIS.

Table 12.3.4 Evaluation of Participants in GIS Training

Items	Evaluation
• Awareness of software license	According to interviews with the participants, unauthorized GIS software (ArcGIS 9) was utilized after the installation of authorized GIS software (ArcGIS 8.3). Therefore, awareness of GIS software license is not fully understood. It is necessary to increase this awareness continually.
• Understanding of data collection by GPS	The participants understood the method of data collection by GPS through the field survey. Some participants have had the experience of using GPS during field surveys.
• Understanding of formulation of the GIS database	The participants understood the formulation of the GIS database through presentations of each GIS database during training.
• Input the positioning data into GIS database	The participants understood the methods of inputting positioning data into the GIS database. However, available methodologies for data inputting were not explained. Therefore, it is necessary for MHC to institute follow up trainings on this subject.

- Formulation of the future plan

According to the flow chart of the GIS training, the JICA Study Team formulated the future plan in coordination with MHC. To make the plan applicable or implementable, it is necessary to estimate budget allocation, human resource administration and implementation schedules.

1) Contents of the future plan

The contents of the future plan are mentioned below.

- Upgrading of the GIS database formulated by the JICA Study Team
- Formulation of the sewerage database for the remaining seven governorates
- Establishment of the GIS sector in MHC and each governorate

2) Implementation Plan for the Future Plan

- Formulation and Upgrading of the GIS Database in this Study

The work required in the formulation and upgrading of GIS databases is shown in **Table 12.3.5**. However, the implementation schedule and cost estimation of this work segment were not done due to uncertainty in the number of the target facilities, pollution sources and water sources. Therefore, in accordance with the sub-contract, the required period for the GIS formulation and upgrading is presented in **Table 12.3.6** for reference, in case MHC carries out the field survey.

Table 12.3.5 Required Works for Formulating and Upgrading of GIS Database

Required Works for Formulating and Upgrading of GIS database	Target Items and Method of Formulating and Upgrading for GIS database
Upgrading of the GIS database formulated by the JICA Study Team	• The target items: upgrading of collected data (137 points) and collection of data on the remaining target facilities for the sewerage system in the target seven (7) governorates • Method: MHC and each governorate carry out field survey by using GPS and questionnaire
Formulation of the sewerage database for remaining seven (7) governorates	• The target items: collection of the remaining target facilities for the sewerage system in the target seven (7) governorates • Method: MHC and each governorate carry out field survey by using GPS and questionnaire
Establishment of the GIS sector in MHC and each governorates	• Target organization: MHC, Sewerage company and general establishments in water and sewerage • Method: Structure of GIS sector, Staffing GIS engineers and Allocation of budget

Table 12.3.6 Required Period for Data Collection

Required Items	Quantity	Period
Data Collection (Positioning data and Questionnaire)	15 locations/ group 1 group = 2 persons	1 week
Input the Collected Data	100 locations / 2 persons	2 weeks

➢ Establishment of the GIS sector in MHC and each governorate

According to discussions with MHC and interviews with the seven governorates, options for the establishment of a GIS sector in MHC and each governorate are recommended. The details of each option for the establishment of the GIS sector are shown in **Table 12.3.7**. The required equipment and staff components are shown in **Table 12.3.8**. The network system between MHC and each

branch is shown in **Figure 12.3.2,, Figure 12.3.3 and Figure 12.3.4**.

Table 12.3.7 Detail of Each Option for the Establishment of GIS Sector

Option	Detail
Option-I	• This option is the advanced plan for the GIS sector. • MHC serves as the head office of the GIS sector and establishes branch offices in each governorate. Branch offices will also be set up in the head office where the JICA Study Team will install ArcView 8.3. (for example; General Establishment of Water and Sewerage) • In the head office, the system of support to be used by MHC in its linkage with each governorate will consist of one ArcInfo, 2 ArcEditor and 10 ArcView. • A Mobile GIS will be used for the field survey instead of the GPS. • In each of the offices, the internal system which all users can apply is the Map Server.
Option-II	• This option is the basic plan for the GIS sector. • MHC serves as the head office of the GIS sector and establishes branch offices in each governorate. Branch offices will also be set up in the head office where the JICA Study Team will install ArcView 8.3. (for example; General Establishment of Water and Sewerage) • In the head office, the system of support to be used by MHC in its linkage with each governorate will consist of one ArcInfo, one ArcEditor and one ArcView. . • GPS with an accuracy rate of from 5m to 10m will be used for the field survey. • In each of the offices, the internal system which all users can apply is the Map server.
Option-III	• This option is a plan for the instruction stage of the GIS sector. • MHC serves as the head office of the GIS sector and establishes branch offices in each governorate. Branch offices will also be set up in the head office where the JICA Study Team will install ArcView 8.3. (for example; General Establishment of Water and Sewerage) • In the head office, the system of support to be used by MHC in its linkage with each governorate will consist of one ArcInfo, one ArcEditor and one ArcView. . • GPS with an accuracy rate of from 5m to 10m will be used for the field survey.

Note) Mobile GIS consists of mobile computer, ArcPad for mobile computers and GPS. Map server is internal network that can be used as reference for decision makers.

Table 12.3.8 Required Equipments and Staffs in GIS Sector

Items	Option-I	Option-II	Option-III
Sector structure	• Head office; MHC • Branch office; 14 governorates	• Head office; MHC • Branch office; 14 governorates	• Head office; MHC • Branch office; 14 governorates
Required number of GIS engineers	• Head office; 13 engineers • Branch office; two engineers in each branch, 28 engineers in total	• Head office; three engineers • Branch office; two engineers in each branch, 28 engineers in total	• Head office; three engineers • Branch office; two engineers in each branch, 28 engineers in total
Required equipment	• Head office; one ArcInfo, two ArcEditor, 10 ArcView, 14 Mobile GIS and one Map server • Branch office; one ArcView, one Mobile GIS and one Map server in each branch	• Head office; one ArcInfo, one ArcEditor, one ArcView, one GPS and one Map server • Branch office; one ArcView, one GPS and one Map server in each branch	• Head office; one ArcInfo, one ArcEditor, one ArcView and one GPS • Branch office; one ArcView and one GPS in each branch

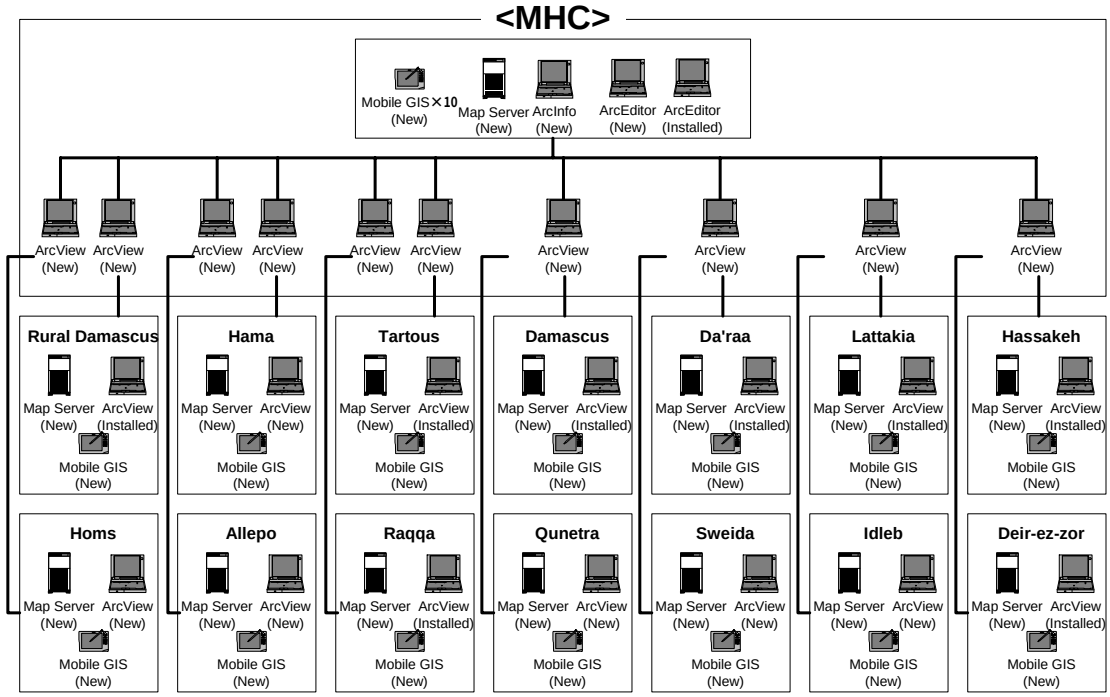

Figure 12.3.2 Structure of the Required Equipment for GIS Sector (Option-I)

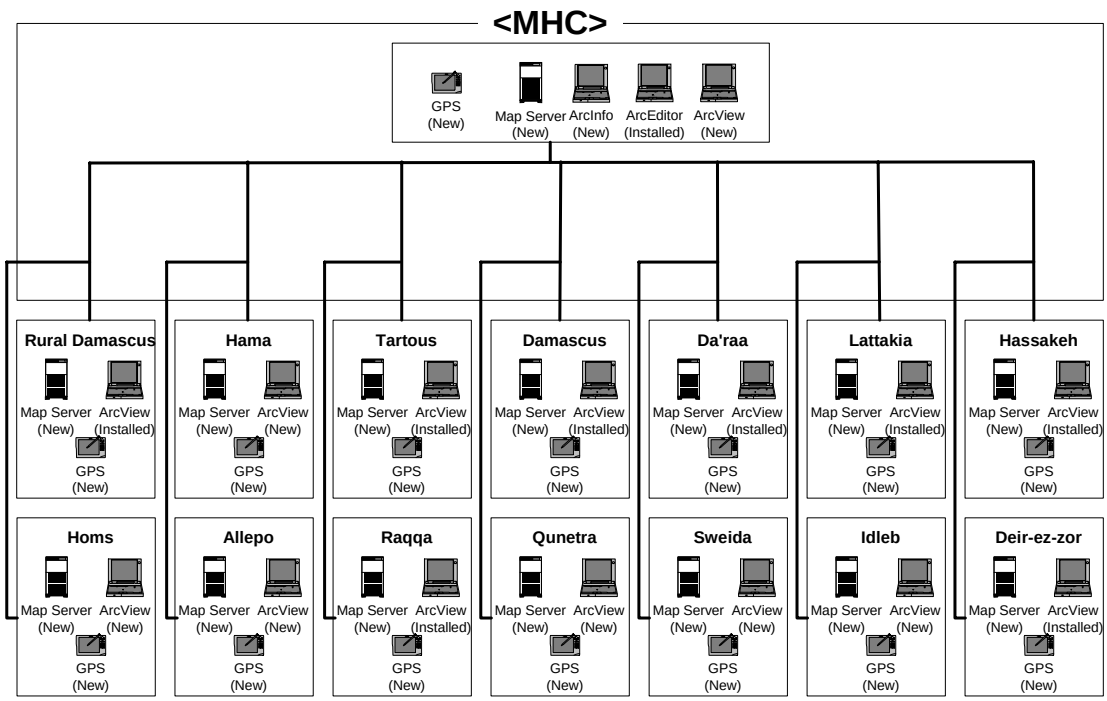

Figure 12.3.3 Structure of the Required Equipment for GIS Sector (Option-II)

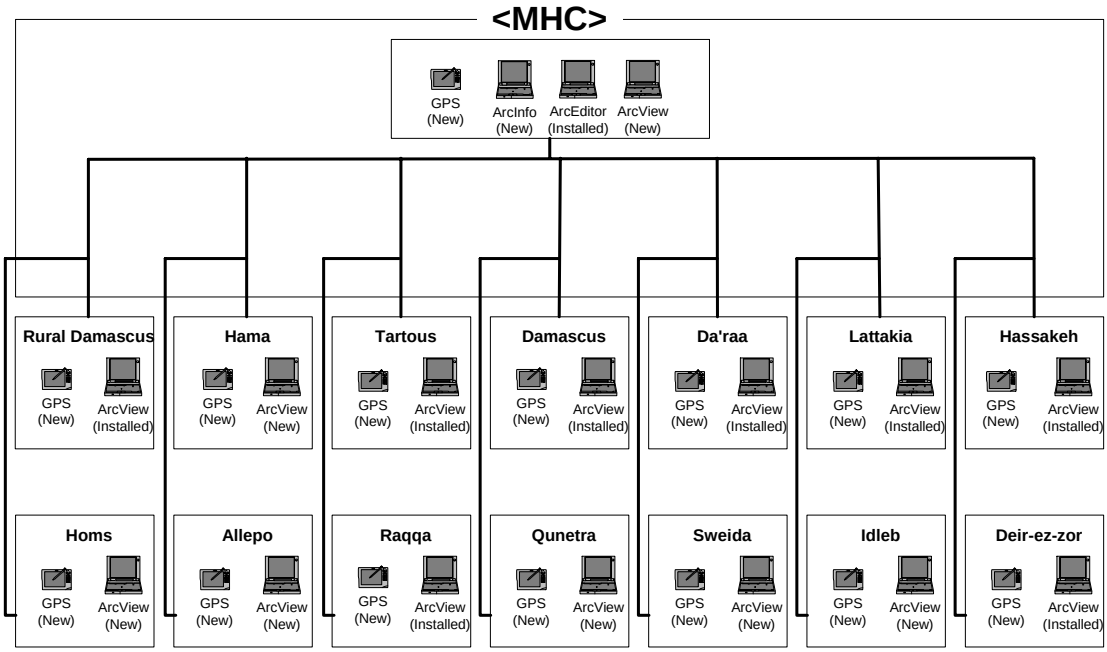

Figure 12.3.4 Structure of the Required Equipment for GIS Sector (Option-III)

3) Cost Estimation

The cost estimation of each of the options for the installation of the required equipment for the GIS sector is shown in the **Table 12.3.9**.

Table 12.3.9 Cost Estimation of Each Option for the Structure of the Required Equipment for GIS Sector

Equipments	Unit Price (S.P)	Option-I		Option-II		Option-III		Remark
		Quantity	Cost (SP)	Quantity	Cost (SP)	Quantity	Cost (SP)	
<MHC>								
Arc Info 8.3	1,110,000	1	1,110,000	1	1,110,000	1	1,110,000	
Arc Editor 8.3	520,000	1	520,000	1	520,000	1	520,000	1 license was installed in MHC
Arc View 8.3	150,000	10	1,500,000	1	150,000	1	150,000	
Mobil GIS	295,000	10	2,950,000	0	0	0	0	
GPS	15,000	0	0	1	15,000	1	15,000	
Map Server	0	1	0	1	0	0	0	
Sub total			6,080,000		1,795,000		1,795,000	
<All Governorates>								
Arc View 8.3	150,000	7	1,050,000	7	1,050,000	7	1,050,000	7 licenses were installed in seven governorates
Mobil GIS	295,000	14	4,130,000	0	0	0	0	
GPS	15,000	0	0	14	210,000	14	210,000	
Map Server	0	14	0	14	0	0	0	
Sub total			11,260,000		3,055,000		3,055,000	
Total (SP)			**17,340,000**		**4,850,000**		**4,850,000**	

4) Evaluation of the options

In terms of the required equipment and cost estimates for each option, option-III appears to be in line with the current conditions of MHC.

Option-I prescribes the appropriate equipment for GIS work and the system can respond to the inquiries from all the governorates in Syria. However, the cost entailed by option-I is high. It may also be difficult to implement this option within a short period of time due to a tight budget.

The costs entailed by Option-II are the same as Option-III. Option-II prescribes a map server for the reference of decision makers in the sewerage department. Therefore, it is practical and necessary to install additional equipment such as computers and network cables. Furthermore, the arrangement of the system for Option-II may turn out to be complicated in the short term. Considering the requirements for a cost-effective and applicable GIS system, Option-III is the one recommended as first step in the establishment of the GIS sector.

12.4 Possible Application of GIS for Sewerage System Management

Using GIS as a management tool can facilitate the carrying out of the following main work centers relative to sewerage system management. GIS provides an ideal means of describing sewer infrastructure facilities, identifying problems and recommending solutions, scheduling and recording maintenance activities, and supporting technical analysis of the facilities. The

following are possible applications of the GIS for management.

- Information management for specifications of sewerage facilities and the conditions of operation and maintenance
- Simulation of pollution load in public water bodies
- Establishment of monitoring system for water quality
- Hydrological and hydraulic evaluation for sewerage system
- Efficient construction works of sewer pipeline
- Improvement of sewerage service and accountability

(1) Information Management for Specifications of Sewerage Facilities and the Conditions of Operation and Maintenance

The first step to the efficient management of the utility is to understand existing conditions. Without this, no utility manager could manage the utility properly and appropriately. To do this, information on the conditions of the sewerage facilities and operation and maintenance should be collected and stored in the GIS. The GIS helps in providing the needed information whenever and wherever it is required; i.e., in case of facilities replacement due to aging and accidents, and emergency countermeasures to mitigate the effects of disasters.

(2) Simulation of Pollution Load in Public Water Bodies

In the crafting of the sewerage plan, it is necessary to understand the pollution load. The collected information regarding pollutant sources such as industrial plants and livestock farms should be utilized for the simulation of pollution load. GIS helps assign direction and speed to a drainage/sewer layer to simulate the fate of usual or accidental contaminants released by an industrial plant/livestock farm through the drainage/sewer network.

(3) Establishment of Monitoring System for Water Quality

Various spatial data layers can be combined and manipulated in a GIS to address planning, operation and maintenance, and management issues. GIS can be used to assign position relation between topography and pollutant source, and determine the location of monitoring point for water quality.

(4) Hydrological and Hydraulic Evaluation for Sewerage System

GIS can be used to develop hydrologic and hydraulic computer models for the sewerage system. In order to solve the hydrological and hydraulic problems, the conditions and performance of those parts need to be clarified. These may be clarified and solved by relating the GIS to the network analysis software. In the GIS, the location and attribute information on drainage and sewer networks can be inputted into database, and the parts which have hydrological and hydraulic problems can be identified. The main results of network analysis are head loss and velocity. Those parts of the networks for which the obtained main results do not satisfy

requirements of the system will have to be repaired/replaced.

(5) Efficient Construction Works of Sewer Network

In order to implement effective and accident-proof construction work in pipe-laying, it is necessary to confirm the location and specifications of underground facilities such as distribution pipelines, gas pipelines and electric cables at the construction site. In GIS, the location and attribute information of these networks can be inputted into database for this purpose. During the pipelaying and construction, the required details can be obtained immediately from the GIS database. After the construction, the construction records, including as-built drawings should be stored in the GIS database for the utilization or information purposes of other organizations.

(6) Improvement of Sewerage Service and Accountability

GIS topology provides information on how the network elements are connected to each other and where the direction of the flow leads to. This capability makes the GIS ideally suitable for identifying customers of a utility network who are affected by service interruptions, such as sewer pipe breaks. Furthermore, the GIS can be used to strengthen the accountability of sewerage works through the visible presentation of the GIS database.

12.5 Recommendations

(1) Continuance of the Formulation of the Sewerage System Database

The formulation of the sewerage system database was carried out as a pilot project. The number of target facilities is from 15 to 27 locations in each governorate, 137 in the total of seven governorates. However, it is necessary to input information concerning all facilities, such as sewerage facilities (sewage treatment plant, pumping station and trunk sewer), point sources of water pollution (industrial plant and live stock farms) and water sources (wells, intake points of rivers and springs) for the improvement of sewerage planning and sewerage service. Updating of GIS database shall be continued by MHC.

According to the draft training program proposed by MHC, a “GIS Section” (temporally named) will be established at the MHC headquarter and the seven Governorates (Establishments). The staff assigned to the GIS section will exclusively conduct the GIS database formation work. MHC created three levels of training, namely, Elementary Level, Intermediate Level and Advanced Level. Each level will take about one month to complete followed by one month of practicum. Upon accomplishment of the three levels, the trainees can take the GPS course for two weeks.

Because of the need for effective methods of data updating, MHC shall establish a future plan for GIS data collection. The future plan will consists of a procurement plan for GIS software

and GPS (Global Positioning System), an implementation plan and cost estimation. Based on this future plan, MHC can establish close relations with the person in charge of the GIS in the seven governorates and facilitate the GIS data collection.

(2) Sharing of GIS Database

Several organizations have formulated GIS databases as a part of their different activities. However, the sharing system for the GIS database has not been established in Syria. As a consequence, each organization has wasted time and resources for activities, such as studies and construction. In the interest of efficiency and effectiveness, it is necessary to improve the effectiveness of GIS database by sharing information on infrastructure development including water supply system, gas and electricity, and future planning. The integrated GIS is a useful system for sharing databases, being a cross-section system which all users in a network can access. However, it is important to complete the collection of current data from each organization before the installation of the integrated GIS system.

(3) Management of Software License for GIS

As a result of the economic sanction imposed by the United States, the JICA Study Team legally procured "ArcEditor 8.3" and "ArcView 8.3" with the hardware key as GIS software. (The latest version is "9.1".) In starting the GIS software, it is necessary to install the hardware key in the computer to prevent usage of an illegally-copied software. Therefore, it is recommended that MHC should acquire the pertinent software license for the prevention of illegal use.

In the interest of the proper management of the software license, MHC shall select a GIS engineer. The selected person should have the legal and moral consciousness to safeguard property rights and copyright, and be able to manage files relevant to GIS, application software and satellite image. The hardware key for GIS software shall be stored in a secure space.

(4) Management of Information Security

The information in the GIS database has the overwhelming potential to increase the efficiency of sewerage work. Meanwhile, a concern arises for the unauthorized release or loss of prepared and compiled information, destruction or deterioration of the function of information management, unauthorized access and security damages.

Since security is paramount to secure the GIS database, it is recommended that a specialized section of the GIS shall be established to safeguard the security of all information. The GIS engineer assigned to this section will be responsible for the required equipment such as the GPS, computer, scanning machine, GIS software and security software to be procured. These equipment shall be stored in a locked space and managed only by the authorized GIS engineer.

CHAPTER 13 SOCIAL CONSIDERATION AND INITIAL ENVIRONMENTAL EXAMINATION

13.1 Environmental and Social Considerations

In 1995, a draft EIA (Environmental Impacts Assessment) decree was prepared during the METAP (Mediterranean Environmental Technology Assistance Program) project which major purpose is to prepare an environmental protection law. In 2002, an EIA unit (now as directorate) was set up within the GCEA (General Commission for Environmental Affairs) under the same METAP project. Since 2005 the GCEA has started to revise and update the draft EIA decree as a law with the cooperation of GTZ (Institution Support to the Syrian Water Sector). The Decree of EIA procedures was submitted to Syrian Environmental Protection Council in February, 2007. It is reported that the Decree will be submitted to prime minister for approval after asking for the comments from related ministries.

According to Executive Instruction (by law) for Environmental Protection Law No. 50 of 2002, modified by the Law No. 17 of 2004, sewerage system development project is not included in the list of the projects that need EIA. However, EIA studies for internationally funded projects have often been conducted by international organizations voluntarily. According to "Minutes of Meeting on the Preparatory Study for the Study on Sewerage System Development in the Syrian Arab Republic" agreed upon between Ministry of Housing and Construction (hereafter called as MHC) and Japan International Cooperation Agency (hereafter called as JICA), JICA Guidelines for Environmental and Social Considerations are applied to the Study.

The procedures of environmental and social considerations on the Projects are showed in **Figure 13.1.1**.

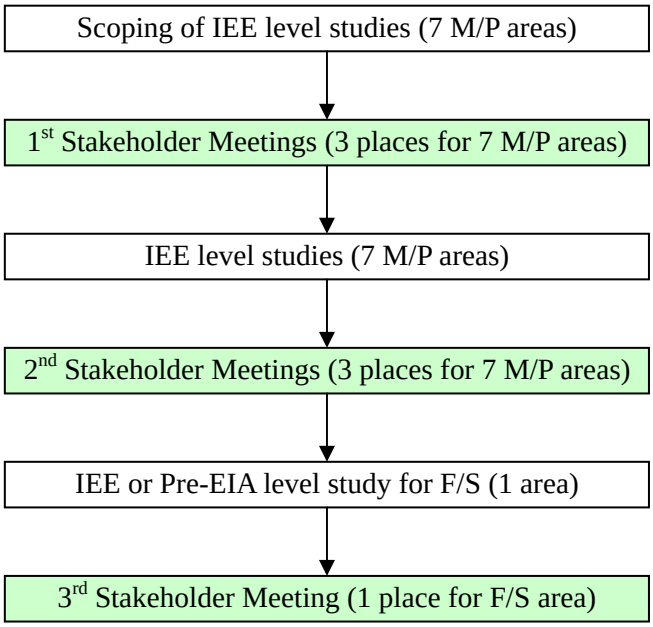

Figure 13.1.1 Procedures of Environmental and Social Considerations

As showed as in **Figure 13.1.1**, three Stakeholder Meetings are planned to be held at three governorates considering accessibility of local stakeholders and to introduce the progresses and results of the Study, and scope and results of IEE level study conducted by MHC with support of the JICA Study Team. The details of the Meetings are showed in **Table 13.1.1**.

Table 13.1.1 Original Plan and Contents of Stakeholder Meetings

Stakeholder Meeting	1st	2nd	3rd
Timing	Feb.-Mar. 2007 (Phase I)	Aug.-Sep. 2007 (Phase II)	Nov. 2007 (Phase III)
Place	Damascus: (Rural Damascus and Dar'aa) Lattakia: (Lattakia and Tartous) Deir-Ez-zor: (Deir-Ez-zor, Raqqa and Hassakeh)		Damascus: (Priority area)
Attendants	Relevant government agencies (MHC, GCEA, governorates, DFEAs etc.) and local stakeholders (residents, NGOs and media etc.) Total: approximately 70 persons		Same as the left Total: approximately 50 persons
Contents of Presentation	1) The outline and progress of M/P 2) Explanation of JICA and Syrian guidelines for environmental and social considerations 3) Scoping of IEE level study	1) The results of M/P 2) The results of IEE level study 3) The contents of F/S and scoping of EIA level study (only for priority area), if necessary	1) The results of F/S 2) The results of EIA study in case of the EIA level study being conducted

(1) Preparation of the Stakeholder Meetings

In order to ensure that the Stakeholder Meetings could be conducted effectively, a taskforce for implementing the Stakeholder Meetings was established by MHC in collaboration with the JICA Study Team. The major activities of the taskforce are summarized as **Table 13.1.2**.

Table 13.1.2 The Major Activities at Preparation Period

Activities		Details of Activities
1	Discussion and decision on the date and place of the Stakeholder Meetings	The Stakeholder Meetings are decided to be held at Deir-Ez-zor City, Lattakia City and Damascus City, considering the accessibility of the stakeholders.
2	Discussion on notification methods of the Meetings	The stakeholders are notified by fax, poster, telephone, direct visit etc., 1 week to 2 weeks ago.
3	Consultation about the scope of stakeholders	Not only relevant government agencies and residents directly affected by the project, but also NGOs, international donors and academic researches are selected and invited.
4	Consultation about the scope of IEE level studies and discussion on the contents of the Meetings	Preparation of consultation program and draft scope of IEE level studies.
5	Preparation of materials for the Meetings	Preparation of agenda, presentation materials, comment sheet in English and Arabic.
6	Others	Arrangement and preparation of the Stakeholder Meetings' room and equipment etc.

(2) Timing and Place of the Stakeholder Meetings

Based on the consultation with MHC, 1st and 2nd Stakeholder Meetings are held. The details of

the Meetings such as the place and timing of the Meetings are showed in **Table 13.1.3** and **Table 13.1.4**.

Table 13.1.3 Timing and Place of the 1st Stakeholder Meeting

Items	Lattakia	Damascus	Deir-Ez-zor
Timing	10:00 – 12:50 27 February 2007	10:00 – 13:00 1 March 2007	10:00 – 12:30 4 March 2007
Place	Meridien Hotel	Sheraton Hotel	Furat Cham Hotel
Target Areas	Lattakia and Tartous Governorates	Rural Damascus and Dar'aa Governorates	Deir-Ez-zor, Raqqa and Hassakeh Governorates

Table 13.1.4 Timing and Place of the 2nd Stakeholder Meeting

Items	Deir-Ez-zor	Lattakia	Damascus
Timing	11:00 – 15:00 9 September 2007	11:00 – 15:00 11 September 2007	11:00 – 13:30 16 September 2007
Place	Furat Cham Hotel	Meridien Hotel	Cham Palace Hotel
Target Areas	Mayadin, Malkieh and Thawra	Slunfeh and Banias	Zabadani and Muzerib

(3) Participants of the Stakeholder Meetings

The number and breakdown of stakeholders that participated in 1st and 2nd Stakeholder Meetings at three governorates are summarized in **Table 13.1.5** and **Table 13.1.6**, respectively. The lists of participants are showed in **Appendix 13**.

Table 13.1.5 Participants of the 1st Stakeholder Meeting

Category of Participants	Lattakia	Damascus	Deir-Ez-zor
Central ministries, relevant government agencies	4	12	3
Local goverments	55	30	19
NGOs	3	2	2
International organizations/donors	0	1	0
University and research institutes	3	3	2
Private sector	1	1	0
Representative of local residents	14	8	4
Media (TV, radio and newspaper etc.)	12	0	8
JICA Syrian Office	0	2	0
JICA Study Team (including other JICA projects)	4	10	4
Others	3	4	3
Total	**99**	**73**	**45**

Table 13.1.6 Participants of the 2nd Stakeholder Meeting

Category of Participants	Deir-Ez-zor	Lattakia	Damascus
Central ministries, relevant government agencies	13	47	28
Local goverments	12	24	11
NGOs	3	2	3
International organizations/donors	0	0	5
University and research institutes	0	3	2
Private sector	3	0	1
Representative of local residents	2	0	0
Media (TV, radio and newspaper etc.)	3	1	10
JICA Syrian Office	2	0	3
JICA Study Team	5	5	11
Others	0	2	1
Total	**43**	**84**	**75**

(4) Consultation Program

Three Stakeholder Meetings are held at three governorates for seven target governorates along the program shown in **Table 13.1.7** and **Table 13.1.8** for 1st and 2nd Stakeholder Meetings in accondance with the JICA Guidelines.

Table 13.1.7 Program of the 1st Stakeholder Meetings at Three Governorates

Program	Oranization in Charge
Opening Statment	Governor of Lattakia; Director of MHC etc.
Part I: Outline and Progress of the JICA Study	Mr. H. Sano, Team Leader, JICA Study Team
Part II: EIA for Sanitary Engineer	Eng. Maher Alkhatib or Mr. Thaer Janem, MHC
Part III: Explanation of the JICA and Syrian Guidelines for Environmental and Social Considerations	Dr. R. Matsue, Environmental Impact Assessment and Social Relations Questionnaire Survey, JICA Study Team
Part IV: Plan of Stakeholder Consultation Meeting and Scoping of IEE Level Study	
Coffee Break	
Part V: Questions and Answers	All stakeholders
Closing Remarks	Dr. Wassim Fallouh and Eng. Ghassan Tarboush, MHC; Ms. Y. Honda, JICA Syrian Office

Table 13.1.8 Program of the 2nd Stakeholder Meetings at Three Governorates

Program	Oranization in Charge
Opening Statment	Vice Minister of MHC; Vice Governor of Lattakia; Resident Representative of JICA Syrian Office; Director of Sewerage Department of MHC etc.
Part I: Outline of M/P Study in the JICA Study	Mr. H. Sano, Team Leader, JICA Study Team
Part II: Explanation of the Resutls of IEE Level Study	Dr. R. Matsue, Environmental Impact Assessment and Social Relations Questionnaire Survey, JICA Study Team
Coffee Break	
Part III: Questions and Answers	All stakeholders
Closing Remarks	Ms. Murakami, JICA Syrian Office; Eng. Ghassan Tarboush and Dr. Wassim Fallouh, MHC.

Table 13.1.8 Program of the 2nd Stakeholder Meetings at Three Governorates

Program	Oranization in Charge
Lunch	All stakeholders

(5) Main Topics Discussed

The main topics discussed in 1st and 2nd Stakeholder Meetings and provided in form of comment sheet are summarized as **Table 13.1.9** and **Table 13.1.10**, respectively.

Table 13.1.9 Main Topics Discussed in 1st Stakeholder Meetings

Question and Comments		Answer
1	At present, combined system is applied in Syria. However, it is desired that in future a separate system could be introduced considering pollution control of wet-weather.	Collection method (combined system or separate system) will be examined and selected by considering geographical features, climate, situation of existing collection method etc..
2	It may take a longer time and huge cost for the construction of centralized STP; therefore, decentralized STPs should be considered during M/P study. Furthermore, natural treatment method also should be considered for decentralized area.	This matter will be examined and studied during the M/P Study in view of technology, operation and maintenance, cost, environmental and social impacts.
3	At present, the wastewaters from hospitals and factories are discharged into sewer system without appropriate pre-treatment. The countermeasures have to be considered during the M/P study.	During the M/P Study some recommendations dealing with industrial wastewater will be prepared.
4	The possibility of JOHKASOU application in Syria should be examined and studied for decentralized residential area.	The possibility of JOHKASOU application will be considered based on comparative study of cost, operation and maintenance.
5	What is correlation between the JICA Guidelines for Environmental and Social Considerations and other International Organizations' guidelines (such as EU Guidelines, ADB Guidelines).	New JICA Guidelines are modified by referring EU Guidelines, World Band Environmental Sourcebook, ADB Environmental Assessment Guidelines etc..
6	The impact of offensive odor from STP and the countermeasures should be considered.	This matter will be considered adequately in the M/P study, and some mitigation measures will be recommended.
7	It should take considerations to reuse treated wastewater for irrigation. In case of the sewage sludge from STP being used for agriculture, the heavy metals problem should be taken into consideration.	During the IEE level study, MHC and the JICA Study Team will pay attention on this matter, and the results will be showed in 2nd Stakeholder Meeting.
8	Groundwater pollution generated by treated wastewater or sludge should be considered.	Reuse and discharge methods of treated wastewater and sludge will be examined during the M/P study and the IEE level study.
9	Adequate and additional technical transfer should be conducted during and after this development study.	This matter will be considered by JICA side.

Table 13.1.10 Main Topics Discussed at the 2nd Stakeholder Meetings

Question and Comments		Answer
1	Did you take into consideration to cover whole	The M/P Study covers seven governorates by choosing

Table 13.1.10 Main Topics Discussed at the 2nd Stakeholder Meetings

Question and Comments		Answer
	governorates in the M/P Study?	one target area in each governorate. In future, the Syrian Side will continue the work to cover whole governorates.
2	Did you take into consideration the future urban expanding and the human activities in target areas like the new industrial city in Deir-ez-Zor (industrial wastewater) which well be established in 2009?	M/P study noted this point and determined 2025 as a target year which means that the JICA Study Team takes the population, urban expanding and the future activities into consideration. Also, the industrial wastewater treatment is included in M/P study.
3	Combined system is used for sewerage system in Syria. It is better to use the old network for storm-water in some places in the target areas and install a new network for sewage (as individual system) especially in areas which have bigger amount of rainfall like Malkieh.	It depends upon the old network capacity, the diameters of the pipelines, climate condition and the population density in the target area.
4	What factors have to be considered during selecting the proper STP location and the treatment method?	It depends upon the topographical and geographical situation, population density, the natural conditions (environmental and social considerations) and the construction and O/M cost.
5	The development study for the sewerage system in Syria is very important so the JICA Study Team should take into consideration some essential points as following: detailed information about water resources and drinking water consumption; drainage system; population distribution; Syrian water and sludge standards	The JICA Study Team carried out the M/P study considering the characteristics of each target area based on existing information.
6	Medical wastes have negative impacts on the human bodies and environment; whether this matter is considered in the JICA study?	In the M/P Study some recommendations for pre-treatment process of typical industrial wastewater have been prepared.
7	What is reason to select Zabadani as M/P study target area in Rural Damascus?	Zabadani is located at the upstream of Figeh Spring which is the most important water source of Damascus. To protect the ground water from sewage pollution, Zabadani is selected as M/P study target area.
8	Did you make any water quality tests during the IEE level study?	Many field tests have been made to examine the surface water, groundwater and wastewater quality during the IEE level study (COD, PO_4, NH_3, NO_3, Coliform etc.) In addition, laboratory analysis for heavy metals in sludge and soil also is conducted.
9	What is the proper way to treat the STP wastes (sludge, treated wastewater)?	The reuse methods of treated wastewater and sludge may vary with the water quality of treated wastewater and the concentrations of toxic substances. Based on the results of IEE level study, it is recommended to reuse treated sludge for agriculture and reuse treated wastewater for irrigation at some areas where the people reuse raw sewage for irrigation currently. However, a monitoring system has to be established to check the sludge, soil and agricultural products.
10	The impact of offensive odor from proposed STP at Zabadani should be considered, because Zabadani is a famous town for tourism.	In the M/P study for Zabadani STP, in order to reduce the odor from STP, an Oxidation ditch system for wastewater treatment and a mechanical dewatering system for sludge treatment are proposed. In addition, a tree belt and buffer zone around STP site are proposed to mitigate odor impacts. During operation stage, if serious odor problem is identified through proposed

Table 13.1.10 Main Topics Discussed at the 2nd Stakeholder Meetings

Question and Comments		Answer
		monitoring system, other additional measures can be applied. (such as covering OD facilities, introducing deodorization system etc.)

(6) Information Disclosure

The minutes of 1st and 2nd Stakeholder Meetings at three governorates are prepared by MHC collaboration with the JICA Study Team, and are available for public viewing at Sewerage Dept. of MHC. The minutes are provided in English and Arabic. At same time, the information about the JICA projects and environmental and social considerations has been also disclosed through newspapers, internet, TV and radio etc. media. (See **Appendix 13**)

13.2 Summary of the Revised Environmental Scoping

Before opening the Stakeholder Meeting, the JICA Study Team prepared draft scoping of the IEE level study in collaboration with MHC based on collected information and field surveys. During the 1st Stakeholders Meetings, the draft scoping, environmental and social factors to be covered, alternatives plans and examination/study methods of the IEE level study were consulted with stakeholders. The final results of scoping and examination/study methods are summarized in **Table 13.2.1** and **Table 13.2.2**.

Table 13.2.1 Scoping Checklist for Sewerage System (M/P) in Seven Governorates

No.	Environmental Items	Evaluation		Contents
		Without Project	With Project	
Social Environmental				
1	Resettlement	D	C	Land acquisition may be necessary depending on the results of the M/P study.
2	Local economy/land ownership	D	C	Income loss from agriculture by land acquisition will occur, however, local employment may be increased by the construction and operation of sewer and STP.
3	Land use and utilization of local resources	D	D	Some changes of land use may occur, but not significant. Water resources will be improved due to water quality improvement of receiving water body and reuse of treated wastewater.
4	Social institutions such as social infrastructure & local decision-making institutions	D	D	The impact is negligible. On the other hand, technology transfer will be conducted by the Study Team through the Project.
5	Existing social infrastructures and services (such as traffic etc.)	D	C	The construction of the sewers planned may create the impacts on traffic congestion. Therefore, the impacts of traffic congestion should be considered.
6	The poor, ethnic people	D	D	The impact is negligible.
7	Misdistribution of benefit and damage	D	D	Selection and decision on the service area of sewerage system may result in misdistribution of benefit, but not

Table 13.2.1 Scoping Checklist for Sewerage System (M/P) in Seven Governorates

No.	Environmental Items	Evaluation		Contents
		Without Project	With Project	
				significant.
8	Local conflict of interests	D	D	The impact is negligible.
9	Gender	D	D	The impact is negligible.
10	Children's rights	D	D	The impact is negligible.
11	Cultural heritage	D	C	The impacts of the construction of proposed projects on valuable cultural property may occur.
12	Accidents (risk etc.)	D	D	Adequate construction method of the proposed facilities will be considered in the design stage.
13	Public health condition	A	D	Sewerage service rate will increase after the completion of the proposed projects. So the impacts of the proposed projects will be positive.
14	Water usage and rights	D	C	Water rights conflict of reusing treated wastewater may occur in the area near STP.
Natural Environmental				
15	Geographical features	D	D	The scale of the proposed projects is small. Therefore, the change of topography and geology due to excavation and earthfill will be quite limited.
16	Ground subsidence	D	D	No groundwater extraction will be expected.
17	Bottom sediment	C	D	The bottom sediment will be improved by the construction of the STP.
18	Biota and ecosystem	C	D	Biota and ecosystem may be improved with the improvement of Barada river water quality.
19	Meteorology (global warming etc.)	D	D	The impact is negligible.
20	Landscape	D	D	Scale of the facilities is small. The impact of the STP on the unique landscape and on the view from main viewpoints will be considered in the design.
Pollution				
21	Air pollution	D	D	No air pollution sources are expected.
22	Water pollution	A	C	The water quality of receiving water body will be improved. However, The impacts of sewage sludge from the STP on the groundwater of the landfill site should be considered in case of the sludge being disposed at landfill site.
23	Soil pollution	D	C	In case of the sewage sludge from the STP being used for agriculture, the impacts of the sludge on the soil should be considered.
24	Waste	D	C	Excess sludge will be generated when sludge treatment facilities are proposed.
25	Noise and vibration	D	C	During the construction stage of the proposed facilities, the impacts of the noise and vibration created by construction equipment and vehicles on the hospitals, schools and surrounding residents may occur.
26	Offensive odor	C	C	Raw sewage emits odor which can be reduced through the construction of sewerage system. However, odor may be emitted from wastewater and sludge treatment facilities during operation of the proposed STP. Thus further investigations may be necessary to ensure the extent of

Table 13.2.1 Scoping Checklist for Sewerage System (M/P) in Seven Governorates

No.	Environmental Items	Evaluation		Contents
		Without Project	With Project	
				such odor, and the countermeasures for odor should be considered in design stage.

Reference: "Guideline for Environmental and Social Considerations", JICA, 2004 (some modifications being made.)
Note) A: Serious impact is expected B: Somewhat impact is expected
C: Extent of impact is unknown (examination is needed) D: No expected impact

Table 13.2.2 Proposed Study Methods for the Projects (M/P) in Seven Governorates

No.	Environmental Items	Evaluation	Study Method and Alternatives Examination
1	Involuntary resettlement	C	Confirmation of land ownership and residential situation by simple filed survey, information collection of land acquisition procedures etc.
2	Local economy/land ownership	C	Confirmation of residential situation along proposed sewers and at STP sites.
5	Traffic	C	Confirmation of residential situation and current traffic flow along proposed sewers and in the vicinity of sewerage treatment plant (STP) sites
11	Cultural heritage	C	Information collection of cultural heritage from related organizations
14	Water rights	C	Consultation with users etc.
22	Water pollution	C	Information collection (water quality of receiving body and groundwater)
23	Soil pollution	C	Information collection (heavy metals in the soil and sludge generated from existing STP), alternatives examination etc.
24	Waste	C	Information collection (location, type, capacity and leachate measures of existing solid waste disposal sites), alternatives examination for sludge disposal (landfill or agricultural use or reuse as construction materials) etc.
25	Noise and Vibration	C	Confirmation of residential situation (including hospitals, schools etc.) and information collection (current noise and vibration level along proposed sewers and in the vicinity of sewerage treatment plant (STP) sites
26	Offensive odor	C	Confirmation of residential situation around STP sites by a simple field survey and estimation effected area of the odor generated from existing STP by a questionnaire survey etc.

Note) A: Serious impact is expected B: Somewhat impact is expected
C: Extent of impact is unknown (examination is needed) D: No expected impact

13.3 Initial Environmental Examination (IEE)

According to the JICA Guidelines, the IEE level study is defined as a study including analysis of alternative plans, prediction and assessment of environmental impacts, and preparation of mitigation measures and monitoring plans on the basis of secondary data and simple field surveys. During the IEE level studies on seven (7) selected areas (M/P), following methods are used:

(1) Collection and analysis of existing information,

(2) Field survey,

(3) Interview, and

(4) Field and laboratory analysis for water quality and heavy metals in sludge and soil.

13.3.1 IEE Level Study on the M/P of Slunfeh Sewerage System

Based on the scoping of the IEE level study, ten (10) items concerning social environment, natural environment and pollution aspects are checked and the results of the IEE level study are summarized in **Table 13.3.1**. Based on existing information and the result of field survey, no precious fauna and flora in/ around the proposed STP site are identified. In addition, the proposed STP site is not located at preservation area of wildlife, wetlands, national park and culture heritage.

Table 13.3.1 Results of the IEE Level Study on the M/P of Slunfeh Sewerage System

No.	Environmental Items	Evaluation	Remarks
1	Involuntary resettlement	D	Three proposed STP sites are agricultural land or moorland currently and neither structures nor residences exist in it. Thus no resettlement will be required.
2	Local economy/land ownership	C	Part of proposed STP sites is private land. However, only 0.1 ha area for each STP will be necessary. So the impacts are light.
5	Traffic	C	Some new sewers are proposed, which may create negative impacts on traffic during construction period. However, existing traffic flow along proposed sewers is low and the period of impacts will be short.
11	Cultural heritage	D	Based on the information collected, no valuable cultural heritages at STP sites are identified.
14	Water usage and rights	D	No sewage is used for irrigation, therefore, no changes in water usage and rights are expected.
22	Water pollution	D	Water quality of receiving body will be improved. Moreover, the sludge is proposed for agricultural use, so groundwater pollution by sludge is negligible.
23	Soil pollution	C	Sludge generated from STPs is planed to be reused for agriculture. The impacts of heavy metals in the sludge on the soil have to be considered.
24	Waste	D	The quantity of sludge generated from STPs is small (only 2.4 m^3/day), and the sludge will be reused for agriculture, so the impacts of waste on environment are negligible.
25	Noise and Vibration	D	Noise and vibration may be generated by construction equipment and vehicles during construction stage, however, the period of the impact is short and no residential area around proposed STP sites.
26	Offensive odor	C	Odor may be emitted from wastewater and sludge treatment facilities. The residential area is at least 300m away from STP site. Moreover, raw sewage also emits odor. Considering these 2 factors, the impact of odor is considered to be light.

Note) A: Serious impact B: Some impact
C: Light impact D: Negligible impact

In order to mitigate these negative impacts, some countermeasures and recommendations from an environmental viewpoint are given in **Table 13.3.2**.

Table 13.3.2 Recommendations for Slunfeh Sewerage System (M/P)

No.	Impact Items	Recommendations for Mitigation Measures on Negative Impacts
2	Local economy/land ownership	To acquire the land for proposed STP sites following Syrian land acquisition procedures and make consultation with land owners.
5	Traffic	To prepare proper construction plan of sewers and STPs, traffic control plan during construction period.
23	Soil pollution	① To prepare a plan of using sludge for agricultural land. (including application area, method and cost etc.) ② To establish a monitoring system to check the sludge from STP, the soil at agricultural land and farm products etc. (including monitoring parameters, frequency and cost etc.)
26	Offensive odor	① To plant a tree belt around STP sites to mitigate odor. ② To set a buffer zone around STP sites. ③ To establish a monitoring system to check odor level around STP sites.

13.3.2 IEE Level Study on the M/P of Banias Sewerage System

Based on the scoping of the IEE level study, ten (10) items concerning social environment, natural environment and pollution aspects are checked and the results of the IEE level study are summarized in **Table 13.3.3**. Based on existing information and the result of field survey, no precious fauna and flora in/ around the proposed STP site are identified. In addition, the proposed STP site is not located at preservation area of wildlife, wetlands, national park and culture heritage.

Table 13.3.3 Results of the IEE Level Study on the M/P of Banias Sewerage System

No.	Environmental Items	Evaluation	Remarks
1	Involuntary resettlement	D	Proposed STP site is agricultural land currently and neither structures nor residences exist in it. Thus no resettlement will be required.
2	Local economy/land ownership	C	Part of proposed STP site is private land. Income loss from agriculture may occur due to land acquisition (5.1 ha for STP).
5	Traffic	C	Some new sewers are proposed, which may create negative impacts on traffic during construction period. However, existing traffic flow along proposed sewers is low and the period of impacts will be short.
11	Cultural heritage	D	Based on the information collected, no valuable cultural heritages at STP site are identified.
14	Water usage and rights	D	No sewage is used for irrigation, therefore, no changes in water usage and rights are expected.
22	Water pollution	D	Water quality of receiving body will be improved. Moreover, the sludge is proposed for agricultural use, so groundwater pollution by sludge is negligible.
23	Soil pollution	C	Sludge generated from STP is planed to be reused for agriculture. The impacts of heavy metals in the sludge on the soil have to be considered.
24	Waste	D	The quantity of sludge generated from STPs is not big (18.4 m^3/day), and the sludge will be reused for agriculture, so the impacts of waste on environment are negligible.
25	Noise and Vibration	D	Noise and vibration may be generated by construction equipment and vehicles during construction stage, however, the period of the impact is short and no residential area around proposed STP site.
26	Offensive odor	C	Odor may be emitted from wastewater and sludge treatment facilities. In order to reduce odor, mechanical dewatering system is proposed for sludge treatment. Moreover, raw sewage also emits odor. Considering these 2 factors, the impact of odor is considered to be light.

Note) A: Serious impact B: Some impact
C: Light impact D: Negligible impact

In order to mitigate these negative impacts, some countermeasures and recommendations from an environmental viewpoint are given in **Table 13.3.4**.

Table 13.3.4 Recommendations for Banias Sewerage System (M/P)

No.	Impact Items	Recommendations for Mitigation Measures on Negative Impacts
2	Local economy/land ownership	To acquire the land for proposed STP site following Syrian land acquisition procedures and make consultation with land owners.
5	Traffic	To prepare proper construction plan of sewers and STP, traffic control plan during construction period.
23	Soil pollution	① To prepare a plan of using sludge for agricultural land. (including application area, method and cost etc.) ② To establish a monitoring system to check the sludge from STP, the soil at agricultural land and farm products etc. (including monitoring parameters, frequency and cost etc.)
26	Offensive odor	① To plant a tree belt around STP site to mitigate odor. ② To set a buffer zone around STP site. ③ To establish a monitoring system to check odor level around STP site.

13.3.3 IEE Level Study on the M/P of Mayadin Sewerage System

Based on the scoping of the IEE level study, ten (10) items concerning social environment, natural environment and pollution aspects are checked and the results of the IEE level study are summarized in **Table 13.3.5**. Based on existing information and the result of field survey, no precious fauna and flora in/ around the proposed STP site are identified. In addition, the proposed STP site is not located at preservation area of wildlife, wetlands, national park and culture heritage.

Table 13.3.5 Results of the IEE Level Study on the M/P of Mayadin Sewerage System

No.	Environmental Items	Evaluation	Remarks
1	Involuntary resettlement	D	Proposed STP site is located at Furat River beach and neither structures nor residences exist in it. Thus no resettlement will be required.
2	Local economy/land ownership	D	Proposed STP site is public land, so there will be no change of land ownership and economic structure.
5	Traffic	D	There is no major road along proposed sewers and in the vicinity of proposed STP site.
11	Cultural heritage	D	Based on the information collected, no valuable cultural heritages at STP site are identified.
14	Water usage and rights	D	No sewage is used for irrigation, therefore, no changes in water usage and rights are expected.
22	Water pollution	D	Water quality of receiving body will be improved. The sludge is proposed for agricultural use, therefore groundwater pollution by sludge is negligible.
23	Soil pollution	C	Sludge generated from STP is planed to be reused for agriculture. The impacts of heavy metals in the sludge on the soil have to be considered.
24	Waste	D	The quantity of sludge generated from STP is small (7.6 m^3/day), and the sludge will be reused for agriculture, so the impacts of waste on environment are very light or negligible.
25	Noise and Vibration	D	Noise and vibration may generated by construction equipment and vehicles during construction stage, however, the period of the impact is short and no residential area around proposed STP

Table 13.3.5 Results of the IEE Level Study on the M/P of Mayadin Sewerage System

No.	Environmental Items	Evaluation	Remarks
			site.
26	Offensive odor	C	Odor may be emitted from wastewater and sludge treatment facilities. The residential area is more than 500m away from proposed STP site. Moreover, raw sewage also emits odor. Considering these 2 factors, the impact of odor is considered to be light.

Note) A: Serious impact B: Some impact
C: Light impact D: Negligible impact

In order to mitigate these negative impacts, some countermeasures and recommendations from an environmental viewpoint are given in **Table 13.3.6**.

Table 13.3.6 Recommendations for Mayadin Sewerage System (M/P)

No.	Impact Items	Recommendations for Mitigation Measures on Negative Impacts
23	Soil pollution	① To prepare a plan of using sludge for agricultural land. (including application area, method and cost etc.) ② To establish a monitoring system to check the sludge from STP, the soil at agricultural land and farm products etc. (including monitoring parameters, frequency and cost etc.)
26	Offensive odor	① To plant a tree belt around STP site to mitigate odor. ② To set a buffer zone of 200m to 300m around STP site. Within the buffer zone, residence will be not allowed. ③ To establish a monitoring system to check odor level around STP site.

13.3.4 IEE Level Study on the M/P of Malkieh Sewerage System

Based on the scoping of the IEE level study, ten (10) items concerning social environment, natural environment and pollution aspects are checked and the results of the IEE level study are summarized in **Table 13.3.7**. Based on existing information and the result of field survey, no precious fauna and flora in/ around the proposed STP site are identified. In addition, the proposed STP site is not located at preservation area of wildlife, wetlands, national park and culture heritage.

Table 13.3.7 Results of the IEE Level Study on the M/P of Malkieh Sewerage System

No.	Environmental Items	Evaluation	Remarks
1	Involuntary resettlement	D	Proposed STP site is agricultural land currently and neither structures nor residences exist in it. Thus no resettlement will be required.
2	Local economy/land ownership	C	Part of proposed STP site is private land. Income loss from agriculture may occur due to land acquisition (3 ha for STP).
5	Traffic	D	There is no major road along proposed sewers and in the vicinity of proposed STP site.
11	Cultural heritage	D	Based on the information collected, no valuable cultural heritages at STP site are identified.
14	Water usage and rights	D	Proposed STP is near existing sewage discharge point, therefore, the people can use treated wastewater for irrigation.

Table 13.3.7 Results of the IEE Level Study on the M/P of Malkieh Sewerage System

No.	Environmental Items	Evaluation	Remarks
22	Water pollution	D	Water quality of receiving body will be improved. The sludge is proposed for agricultural use, therefore groundwater pollution by sludge is negligible.
23	Soil pollution	C	Sludge generated from STP is planed to be reused for agriculture. The impacts of heavy metals in the sludge on the soil have to be considered.
24	Waste	D	The quantity of sludge generated from STP is small (2.3 m^3/day), and the sludge will be reused for agriculture, so the impacts of waste on environment are very light or negligible.
25	Noise and Vibration	D	Noise and vibration may generated by construction equipment and vehicles during construction stage, however, the period of the impact is short and no residential area around proposed STP site.
26	Offensive odor	C	Odor may be emitted from wastewater and sludge treatment facilities. The residential area is about 1,000m away from proposed STP site. Moreover, raw sewage also emits odor. Considering these 2 factors, the impact of odor is considered to be light.

Note) A: Serious impact B: Some impact
C: Light impact D: Negligible impact

In order to mitigate these negative impacts, some countermeasures and recommendations from an environmental viewpoint are given in **Table 13.3.8**.

Table 13.3.8 Recommendations for Malkieh Sewerage System (M/P)

No.	Impact Items	Recommendations for Mitigation Measures on Negative Impacts
2	Local economy/land ownership	To acquire the land for proposed STP site following Syrian land acquisition procedures and make consultation with land owners.
23	Soil pollution	① To prepare a plan of using sludge for agricultural land. (including application area, method and cost etc.) ② To establish a monitoring system to check the sludge from STP, the soil at agricultural land and farm products etc. (including monitoring parameters, frequency and cost etc.)
26	Offensive odor	① To plant a tree belt around STP site to mitigate odor. ② To set a buffer zone of 200m to 300m around STP site. Within the buffer zone, residence will be not allowed. ③ To establish a monitoring system to check odor level around STP site.

13.3.5 IEE Level Study on the M/P of Thawra Sewerage System

Based on the scoping of the IEE level study, ten (10) items concerning social environment, natural environment and pollution aspects are checked and the results of the IEE level study are summarized in **Table 13.3.9**. Based on existing information and the result of field survey, no precious fauna and flora in/ around the proposed STP site are identified. In addition, the proposed STP site is not located at preservation area of wildlife, wetlands, national park and culture heritage.

Table 13.3.9 Results of the IEE Level Study on the M/P of Thawra Sewerage System

No.	Environmental Items	Evaluation	Remarks
1	Involuntary resettlement	D	Proposed STP site is agricultural land currently and neither structures nor residences exist in it. Thus no resettlement will be required.
2	Local economy/land ownership	C	Part of proposed STP site is private land. Income loss from agriculture may occur due to land acquisition (2.5 ha for STP).
5	Traffic	D	There is no major road along proposed sewers and in the vicinity of proposed STP site.
11	Cultural heritage	D	Based on the information collected, no valuable cultural heritages at STP site are identified.
14	Water usage and rights	D	Proposed STP is near existing sewage discharge point, therefore, the people can use treated wastewater for irrigation.
22	Water pollution	D	Water quality of receiving body will be improved. The sludge is proposed for agricultural use, therefore groundwater pollution by sludge is negligible.
23	Soil pollution	C	Sludge generated from STP is planed to be reused for agriculture. The impacts of heavy metals in the sludge on the soil have to be considered.
24	Waste	D	The quantity of sludge generated from STP is small (4.8 m^3/day), and the sludge will be reused for agriculture, so the impacts of waste on environment are very light or negligible.
25	Noise and Vibration	D	Noise and vibration may generated by construction equipment and vehicles during construction stage, however, the period of the impact is short and no residential area around proposed STP site.
26	Offensive odor	C	Odor may be emitted from wastewater and sludge treatment facilities. The residential area is about 500m away from proposed STP site. Moreover, raw sewage also emits odor. Considering these 2 factors, the impact of odor is considered to be light.

Note) A: Serious impact B: Some impact
C: Light impact D: Negligible impact

In order to mitigate these negative impacts, some countermeasures and recommendations from an environmental viewpoint are given in **Table 13.3.10**.

Table 13.3.10 Recommendations for Thawra Sewerage System (M/P)

No.	Impact Items	Recommendations for Mitigation Measures on Negative Impacts
2	Local economy/land ownership	To acquire the land for proposed STP site following Syrian land acquisition procedures and make consultation with land owners.
23	Soil pollution	① To prepare a plan of using sludge for agricultural land. (including application area, method and cost etc.) ② To establish a monitoring system to check the sludge from STP, the soil at agricultural land and farm products etc. (including monitoring parameters, frequency and cost etc.)
26	Offensive odor	① To plant a tree belt around STP site to mitigate odor. ② To set a buffer zone of 200m to 300m around STP site. Within the buffer zone, residence will be not allowed. ③ To establish a monitoring system to check odor level around STP site.

13.3.6 IEE Level Study on the M/P of Muzerib Sewerage System

Based on the scoping of the IEE level study, ten (10) items concerning social environment, natural environment and pollution aspects are checked and the results of the IEE level study are summarized in **Table 13.3.11**. Based on existing information and the result of field survey, no precious fauna and flora in/ around the proposed STP site are identified. In addition, the proposed STP site is not located at preservation area of wildlife, wetlands, national park and culture heritage.

Table 13.3.11 Results of the IEE Level Study on the M/P of Muzerib Sewerage System

No.	Environmental Items	Evaluation	Remarks
1	Involuntary resettlement	D	Two proposed STP sites are agricultural land currently and neither structures nor residences exist in it. Thus no resettlement will be required.
2	Local economy/land ownership	C	Proposed STP sites are private land. Income loss from agriculture may occur due to land acquisition (4.9 ha for STP).
5	Traffic	C	Some new sewers are proposed, which may create negative impacts on traffic during construction period. However, existing traffic flow along proposed sewers is low and the period of impacts will be short.
11	Cultural heritage	D	Based on the information collected, no valuable cultural heritages at STP sites are identified.
14	Water usage and rights	D	Proposed STP site (Case 1) is near existing sewage discharge point, therefore, the people can use treated wastewater for irrigation.
22	Water pollution	D	Water quality of receiving body will be improved. Moreover, the sludge is proposed for agricultural use, so groundwater pollution by sludge is negligible.
23	Soil pollution	C	Sludge generated from STP is planed to be reused for agriculture. The impacts of heavy metals in the sludge on the soil have to be considered.
24	Waste	D	The quantity of sludge generated from STPs is not big (1.1 m^3/day), and the sludge will be reused for agriculture, so the impacts of waste on environment are negligible.
25	Noise and Vibration	D	Noise and vibration may be generated by construction equipment and vehicles during construction stage, however,

Table 13.3.11 Results of the IEE Level Study on the M/P of Muzerib Sewerage System

No.	Environmental Items	Evaluation	Remarks
			the period of the impact is short and no residential area around proposed STP site.
26	Offensive odor	C	Odor may be emitted from wastewater and sludge treatment facilities. The residential area is about 300m away from proposed STP site. Moreover, raw sewage also emits odor. Considering these 2 factors, the impact of odor is considered to be light.

Note) A: Serious impact B: Some impact
C: Light impact D: Negligible impact

In order to mitigate these negative impacts, some countermeasures and recommendations from an environmental viewpoint are given in **Table 13.3.12**.

Table 13.3.12 Recommendations for Muzerib Sewerage System (M/P)

No.	Impact Items	Recommendations for Mitigation Measures on Negative Impacts
2	Local economy/land ownership	To acquire the land for proposed STP site following Syrian land acquisition procedures and make consultation with land owners.
5	Traffic	To prepare proper construction plan of sewers and STP, traffic control plan during construction period.
23	Soil pollution	① To prepare a plan of using sludge for agricultural land. (including application area, method and cost etc.) ② To establish a monitoring system to check the sludge from STP, the soil at agricultural land and farm products etc. (including monitoring parameters, frequency and cost etc.)
26	Offensive odor	① To plant a tree belt around STP site to mitigate odor. ② To set a buffer zone of 200m to 300m around STP site. Within the buffer zone, residence will be not allowed. ③ To establish a monitoring system to check odor level around STP site.

13.3.7 IEE Level Study on the M/P of Zabadani Sewerage System

Based on the scoping of the IEE level study, ten (10) items concerning social environment, natural environment and pollution aspects are checked and the results of the IEE level study are summarized in **Table 13.3.13**. Based on existing information and the result of field survey, no precious fauna and flora in/ around the proposed STP site are identified. In addition, the proposed STP site is not located at preservation area of wildlife, wetlands, national park and culture heritage.

Table 13.3.13 Results of the IEE Level Study on the M/P of Zabadani Sewerage System

No.	Environmental Items	Evaluation	Remarks
1	Involuntary resettlement	D	Proposed STP site is used as military camp. Thus no resettlement will be required.
2	Local economy/land ownership	D	Proposed STP site (5.5 ha) is public land (belonging to Ministry of Agriculture). So there will be no change of land ownership and economic structure.
5	Traffic	C	Proposed STP is close to major road, the construction of proposed STP may create negative impacts on traffic during construction period. However, existing traffic flow is low and the period of impacts will be short. In addition, some measures will be taken during construction period.
11	Cultural heritage	D	Based on the information collected, no valuable cultural heritages at STP site are identified.
14	Water usage and rights	D	Proposed STP site is near existing sewage discharge point, therefore, the people can use treated wastewater for irrigation.
22	Water pollution	D	Water quality of receiving body will be improved. Moreover, the sludge is proposed for agricultural use, so groundwater pollution by sludge is negligible.
23	Soil pollution	C	Sludge generated from STP is planed to be reused for agriculture. The impacts of heavy metals in the sludge on the soil have to be considered.
24	Waste	D	The quantity of sludge generated from STPs is not big (17.2 m^3/day), and the sludge will be reused for agriculture, so the impacts of waste on environment are negligible.
25	Noise and Vibration	D	Noise and vibration may be generated by construction equipment and vehicles during construction stage, however, the period of the impact is short and no residential area around proposed STP site.
26	Offensive odor	C	Odor may be emitted from wastewater and sludge treatment facilities. The residential area is about 300m away from proposed STP site. Moreover, raw sewage also emits odor. Considering these 2 factors, the impact of odor is considered to be light.

Note) A: Serious impact B: Some impact
C: Light impact D: Negligible impact

In order to mitigate these negative impacts, some countermeasures and recommendations from an environmental viewpoint are given in **Table 13.3.14**.

Table 13.3.14 Recommendations for Zabadani Sewerage System (M/P)

No.	Impact Items	Recommendations for Mitigation Measures on Negative Impacts
5	Traffic	To prepare proper construction plan of sewers and STP, traffic control plan during construction period.
23	Soil pollution	① To prepare a plan of using sludge for agricultural land. (including application area, method and cost etc.) ② To establish a monitoring system to check the sludge from STP, the soil at agricultural land and farm products etc. (including monitoring parameters, frequency and cost etc.)
26	Offensive odor	① To plant a tree belt around STP site to mitigate odor. ② To set a buffer zone of 200m to 300m around STP site. Within the buffer zone, residence will be not allowed. ③ To establish a monitoring system to check odor level around STP site.

CHAPTER 14 EVALUATION OF THE MASTER PLAN

14.1 Technical Aspects

Present conditions of water pollution in public waters were identified in Chapter 3.4 as shown below.

Table 14.1.1 Main Pollution Sources of Water Quality Problems

Name of River Basin	Water quality pollution /contamination problems	Main Pollution Load Sources
Euphrates River Basin	Water pollution of water sources for Water supply	Domestic and commercial wastewater (outlet of sewer pipe) Public factories which have large amount of pollution load
	Water pollution of living environment	
Khabour River Basin	Water pollution of water sources for irrigation	Domestic and commercial wastewater (outlet of sewer pipe) Public factories which have large amount of pollution load
	Water pollution of living environment	
Barada and Awaj River Basin	Water pollution of surface water for irrigation	non-treated domestic and commercial wastewater Public factories which have large amount of pollution load
	Water pollution of groundwater for water supply and irrigation	Infiltration of polluted river water, which is polluted by Domestic, commercial and industrial wastewater. Infiltration of irrigated water, which is polluted by domestic, commercial and industrial wastewater. Infiltration of irrigated water, which is treated water from sewerage treatment plant Treatment facilities (on-site facilities with penetration type) of domestic wastewater
Coastal Basin	Water pollution of water sources for Water supply	Small-scale olive oil pressing factories are scattered widely Treatment facilities (on-site facilities with penetration type) of domestic wastewater and non-treated domestic wastewater
	Water pollution of sea area (bacteriological contamination)	Domestic and commercial wastewater from sewer pipe without treatment
Yarmouk River Basin	Water pollution of groundwater for water supply	Domestic, commercial and industrial wastewater
	Water pollution of surface water for irrigation	

The proposed sanitation systems (such as sewerage system, decentralized system and on-site system) are expected to be appropriate with regards to demographic, geological, environmental and economic factors in the Study Area.

The water quality of sea water, river water and groundwater are expected to improve after the proposed sewerage system is introduced and/or adequate on-site and decentralized facilities are provided. And decreased overflow from the existing pit latrine and grey water from houses will improve residential amenity.

The activated sludge treatment system and the natural treatment system are the proposed sewage treatment processes for the Study Area. These systems are expected to be adequate in light of the present technical and institutional capacity of Syria. The existing sewage collection facilities will also be improved by the proposed sewer cleaning equipment.

The reuse of treated effluent from the STP for agriculture and watering gardens will conserve water supply resources. The reuse of the dewatered sludge from the STP for agriculture and/or as garden fertilizer will conserve natural and chemical resources. Consequently, implementation of the project will contribute to eco-system preservation.

Industrial wastewater, the major pollution load source shall be treated appropriately.
Countermeasures for pollution control including promotion of "Cleaner Production", introduction of "Industrial Pollution Control Manager (e.g.)"system shall be dully developed.

14.2 Economic and Financial Aspects

14.2.1 Economic Evaluation Results

The Master Plan sewerage system development project is designed to contribute to the public welfare and therefore profitability can hardly be considered as the major mission of this project. Therefore, the Economic Internal Rate of Return (EIRR) approach was primarily used for the project justification.

Results of analysis show that the M/P project as a whole is feasible from the economic point of view. The NPV of the M/P is positive (SP 764.6 million) and the average EIRR is 15.0%. In particular, the calculated EIRR for the Damascus Rural priority area is 18.0%, which is above the M/P average figure. Details are provided in Chapter 11.

The economic benefits associated with the tourism development, reduction of the productive time lost and reduction of the medical expenditures, as well as the economic value of the treated wastewater are the most significant for the entire Master Plan. However, the situation differs from one priority area to another, depending on the concrete circumstances.

14.2.2 Financial Evaluation Results

A detailed financial plan will be prepared at the Feasibility Study stage for the Rural Damascus priority area. Therefore, only an outline of the financial evaluation could be provided for the Master Plan taken as a whole.

The capital costs of the Master Plan project could be financed from different sources, such as for instance the Public Debt Fund, i.e. as a subsidy of the Syrian Government, by taking a soft loan, by grants of international donor agencies, and so on. The concrete sources could be

determined at a later stage of the project development cycle.

Recovery of capital costs of sewerage projects through user charges occurs very rare in the international practice and is not on agenda of the Government of Syria either. Full cost recovery would require a drastic increase of tariffs, which would be not viable. Therefore, it was assumed that the capital costs of the project would be eventually contributed to the respective establishments as a subsidy. Accordingly, no efforts were made to assess financial viability of the capital investment by calculating its Financial Internal Rate of Return (FIRR).

On the contrary, following the best international practice, the O&M costs of the sewerage system upon the project completion should be financed from the revenue generated, i.e. from the sewerage fees. It would represent a very important, but at the same time an attainable target for financial sustainability of the sewerage system throughout the project life.

Despite the situation differs from Governorate to Governorate and can hardly be generalized, it can be roughly estimated, that in order to ensure the 100% recovery of the O&M costs for the Master Plan on average, the sewerage charges excluding inflation should be set as approximately 1.4 SP /m^3, in addition to the annual fee of SYP 120.

14.3 Environmental Aspects

Based on the results of consultation with stakeholders at 1st Stakeholder Meeting for scoping of IEE level study, the IEE level study on the M/P studies for 7 target areas are carried out in August. The results of IEE level study are summarized in **Table 14.3.1**.

Table 14.3.1 Results of the IEE Level Study on the M/P Studies for Seven Target Areas

Environmental Items	Slunfeh	Banias	Mayadin	Malkieh	Thawra	Muzerib	Zabadani
Involuntary resettlement	D	D	D	D	D	D	D
Local economy/land ownership	C	C	D	C	D	C	D
Traffic	C	C	D	D	D	C	C
Cultural heritage	D	D	D	D	D	D	D
Water usage and rights	D	D	D	D	D	D	D
Water pollution	D	D	D	D	D	D	D
Soil pollution	C	C	C	C	C	C	C
Waste	D	D	D	D	D	D	D
Noise and Vibration	D	D	D	D	D	D	D
Offensive odor	C	C	C	C	C	C	C

Note) A: Serious impact B: Some impact
C: Light impact D: Negligible impact

Through the IEE level study, no serious impacts of the proposed projects on environment are identified, except some items having light impacts. In order to mitigate these negative impacts,

some countermeasures and recommendations from an environmental viewpoint are proposed.

14.4 Selection of Priority Project for the Feasibility Study

On the selection of priority project, sewerage system is advantageous comparing to other sanitation systems, such as on-site and decentralized systems, because sewerage project shall be constructed in urban areas with large population and benefits spreads widely. In the sewerage project, providing for the project implementation capacity, financial constrains, urgency to improve the water related environment and man-power resources in related sector, proper target project scale shall be settled for Feasibility Study.

The Feasibility Study site will be extracted from Rural Damascus Governorate based on the signed the M/M and S/W between two governments. And Zabadani Area is selected from Rural Damascus Governorate based on the discussion with the Ministry of Housing and Construction.

The feature of Zabadani Area is located just upstream of Ain Fejeh Spring, which is the largest and most important water source of Damascus. Ain Fejeh is also facing to Barada River. As Zabadani is also well-known as tourist spot, currently status that raw sewage is directly discharges into Barada River have been fiercely damaging the value of Zabadani as tourist resource.

Based on the results of IEE-level investigation, socio-environmental impact expected by project implementation in Zabadani area is seemed to be less owing to the followings:

- As the construction site for the proposed STP in Zabadani area is public-owned, land ownership and land use will not be changed.
- Anticipated impact to local traffic condition, soil contamination and odor emission can be mitigated or minimized by execution of appropriate countermeasures.

Upon comparison with other M/P areas, there was no remarkable difference in environmental items. While, great difference in the following environmental items on examination in “without project case” is anticipated in Zabadani area.

1) Sanitary environment and water pollution

   As Zabadani area is located near to Ain Fijeh Spring the most important water source of Damascus Governorate, there is a great possibility of spring water pollution by discharged raw sewage. Total population might be affected by this is counted as 1.5 million. Furthermore, Zabadani area is extremely famous tourism spot but its value as tourism resource has been damaged by river water pollution caused by raw sewage discharge into Barada river flows through Zabadani area.

2) Water use

Zabadani area has the largest number of farmers utilizing raw sewage as irrigation use. Usage of raw sewage not satisfying the irrigation water standards has serious influence to agricultural products and soil contamination.

As abovementioned, emergency in sewerage system development in Zabadani area was dully confirmed, Zabadani area was selected as F/S target area.