PART II : FEASIBILITY STUDY

Chapter 1 FEASIBILITY STUDY ON SEWERAGE FACILITIES

1.1 General Condition for Feasibility Study

1.1.1 Target Area and Target Year

Zabadani the target area of F/S is located in Rural Damascus Governorate. There are four core cities called Zabadani, Bloudan, Bukein and Madaya. Zabadani and Bloudan belong to Zabadani sub-district. While, Bukein and Madaya belong to Madaya sub-district. These cities are ranging close each another forming one community.

As the elevation of Zabadani is exceeding 1,000m, numerous tourists visit here for comfortable environment during summer season. Therefore, the amount of wastewater in summer increases more than two times of that in winter.

The followings are the basic concept on this Feasibility Study:

- The target year of M/P is 2025. The target year of F/S was set by 2015 as intermediate year to M/P, considering phased project implementation.
- Design and construction of STP is supposed to take about three years. Further, some more years shall be accounted for related arrangements necessary. So until actual STP commission around seven years will be needed from now. Thus the JICA Study Team established F/S target year as 2015 and design plant capacity was also set by wastewater amount estimated to be generated in 2015.

1.1.2 Wastewater Collection System

The general wastewater collection system in Syria is combined system collects wastewater and storm water in one pipe. The existing wastewater collection system in Zabadani is also combined one. Even if in combined system, rain water should be separated from wastewater. [Separation of Rain Water] is studied in **Appendix 1.4**.
In all section, concrete pipe were adopted. However, the quality of domestic concrete pipe is inferior. Some of them are not even reinforced by steel bar. Further, as pipe connection structure is not manufactured precisely, pipe connection cannot be water-tight. Age of some sewer pipes is exceeding 50 years and they have been already deteriorated. Owing to these conditions, there is great possibility of wastewater leakage from sewer pipe and pipe breakage. The pipe repair or replacement works have been executed in each city.

The wastewater generated in household flows into connected sewer pipe and collected wastewater is discharged to the Barada River through trunk sewer without any treatment. Namely, raw wastewater has been discharged to the public water body. The sewer pipe has

been developed in almost whole urbanized areas. Areas not served by sewer network are served by Pit latrine and stored sludge is periodically withdrawn by vacuum tanker and sludge is dumped into waterway or manhole of sewer network nearby. Thus, this collected sludge is also contributing to public water contamination as another pollution source. Existing manhole was installed at intervals of 20 to 40m. Manhole is constructed for maintenance work of sewer pipe. If solid obstacles are settled at the bottom of sewer pipe, wastewater flow turns stagnant. To maintain smooth wastewater collection, sewer network cleaning has been conducted once in every year. As geographical feature of this area has moderate slope, the sewer pipe was installed relatively shallow.

1.1.3 Per Capita Wastewater Flow and Pollution Load

(1) Per Capita Wastewater Flow

The amount of wastewater was calculated by multiplying the per capita wastewater flow by design service population. Total amount of wastewater is comprised domestic wastewater and others. Wastewater generated in store, office, school and factory is contained in “others”. Per capita domestic water supply in 2004 was presumed as 100 LCD, referring to the existing study. Per capita domestic water supply is assumed to be increased along with living standard improvement in future. Annual increment is estimated as 1 LCD.

The ratio of non-domestic water consumption against domestic water consumption increases according to urbanization degree. So, this ratio becomes low value at small-scale residential area. Since Zabadani is large-scaled city, 30% was adapted. As to other three core cities, namely Bloudan, Bukein and Madaya are middle-scaled cities, the ratio was set be 10%.

Some portion of consumed water converts to wastewater and this ratio is called as wastewater conversion rate. According to existing study, 80% was adapted.

Daily maximum wastewater flow means the maximum amount of wastewater generated through a year. The ratio to daily average wastewater flow was set by 1.2 according to WB Study. Hourly maximum wastewater flow is the hourly peak wastewater within a day. The ratio to daily maximum wastewater flow was set by 1.8 based on WB study.

As stated earlier, target area has moderate slope and therefore, sewer pipes were installed shallow assumed to be located above the groundwater table. So, groundwater intrusion to sewer pipe was neglected.

Zabadani area is well-known tourist resort where attracts many tourists including foreigners by its temperate climate during summer season. Therefore, compared with winter, much larger

amount of wastewater is generated as tourist wastewater flow in summer. Based on EIB Study, its ratio to domestic wastewater flow was set as shown in **Table 1.1.1**:

Table 1.1.1 The Ratio of Tourist Wastewater Flow

City Name	Tourist Wastewater (%)	Domestic Wastewater (%)	Total (%)
Zabadani	200	100	300
Bloudan	300	100	400
Madaya	50	100	150
Bukein	250	100	350

Per capita wastewater flow calculated by the above-mentioned assumptions is shown in **Table 1.1.2** and **1.1.3**:

Table 1.1.2 Per Capita Wastewater Flow (Non-domestic Ratio= 0.3)

(Unit：LCD)

Items	2004	2010	2015	2020	2025
Daily Average Flow (DAF)					
Domestic	100	105	110	115	120
Non-Domestic	30	32	33	35	36
Total	130	137	143	150	156
Conversion ratio			0.8		
Wastewater	104	109	114	120	125
Daily Maximum Flow (DMF) (DMF=1.2×DAF)					
	125	131	137	144	150
Peak Hour Flow (PHF) (PHF=1.8×DMF)					
	225	236	247	258	270
Unaccounted Flow (=DMF×20%)					
	25	26	27	29	30
Design Sewage Unit Flow					
Daily Average	129	135	142	148	155
Daily Maximum	150	157	165	172	180
Peak Hour	250	262	275	287	300

Table 1.1.3 Per Capita Domestic Wastewater Rate (Non-domestic Ratio= 0.1)

(Unit：LCD)

Items	2004	2010	2015	2020	2025
Daily Average Flow					
Domestic	100	105	110	115	120
Non-Domestic	10	11	11	12	12
Total	110	116	121	127	132
Conversion ratio			0.8		
Wastewater	88	92	97	101	106
Daily Maximum Flow (DMF) (DMF=1.2×DAF)					
	106	111	116	121	127
Peak Hour Flow (PHF) (PHF=1.8×DMF)					
	190	200	209	219	228
Unaccounted Flow (=DMF×20%)					
	21	22	23	24	25
Design Sewage Unit Flow					
Daily Average	109	115	120	125	131
Daily Maximum	127	133	139	146	152
Peak Hour	211	222	232	243	253

(2) Pollution Load

Per capita pollution load was set as **Table 1.1.4**, referring to the inflow wastewater quality in Adraa STP.

Table 1.1.4 Average Pollution Load and Design Wastewater Quality

Indices	Average Pollution Load (g/capita/day)	Calculated Wastewater Quality (mg/l)	Design Wastewater Quality (mg/l)
BOD	38.4	248	310
SS	45.3	292	360
T-N	9.3	60	74
T-P	3.0	19	24

Note) BOD loading was assumed based on data in abroad and others were estimated based on actual analysis data in Adraa STP

1.1.4 Facilities designed in F/S Stage

Sewer network has already been developed in these four core cities. Now, wastewater flows through closed conduit and open channel, then discharged into Barada River. In order to mitigate the odor emitted from this open channel section, this portion will be converted to closed conduit by each cities. Closed conduit was planned to be constructed in abandoned railroad line situated along with this open channel. So, no additional trunk sewer shall be designed through this F/S.

Since Zabadani area is hilly area with moderate ground slope, all generated wastewater can be collected by gravity. So, no pumping station is needed.

As existing sewer is combined system, storm water and wastewater are collected by same sewer and flow into trunk sewer. In dry weather, since no storm water is contained, whole wastewater shall be treated by STP. While in wet weather, as large volume of storm water is contained in wastewater, treatment of whole wastewater is not applicable. Some portion of wet weather wastewater shall be treated by STP and the rest shall be discharged to Barada River without treatment. To separate wet weather wastewater, diversion facility was proposed in F/S. STP with design capacity can cope with the generated wastewater flow in 2015 was planned as well.

Sewerage planning map is shown in **Figure 1.1.1**.

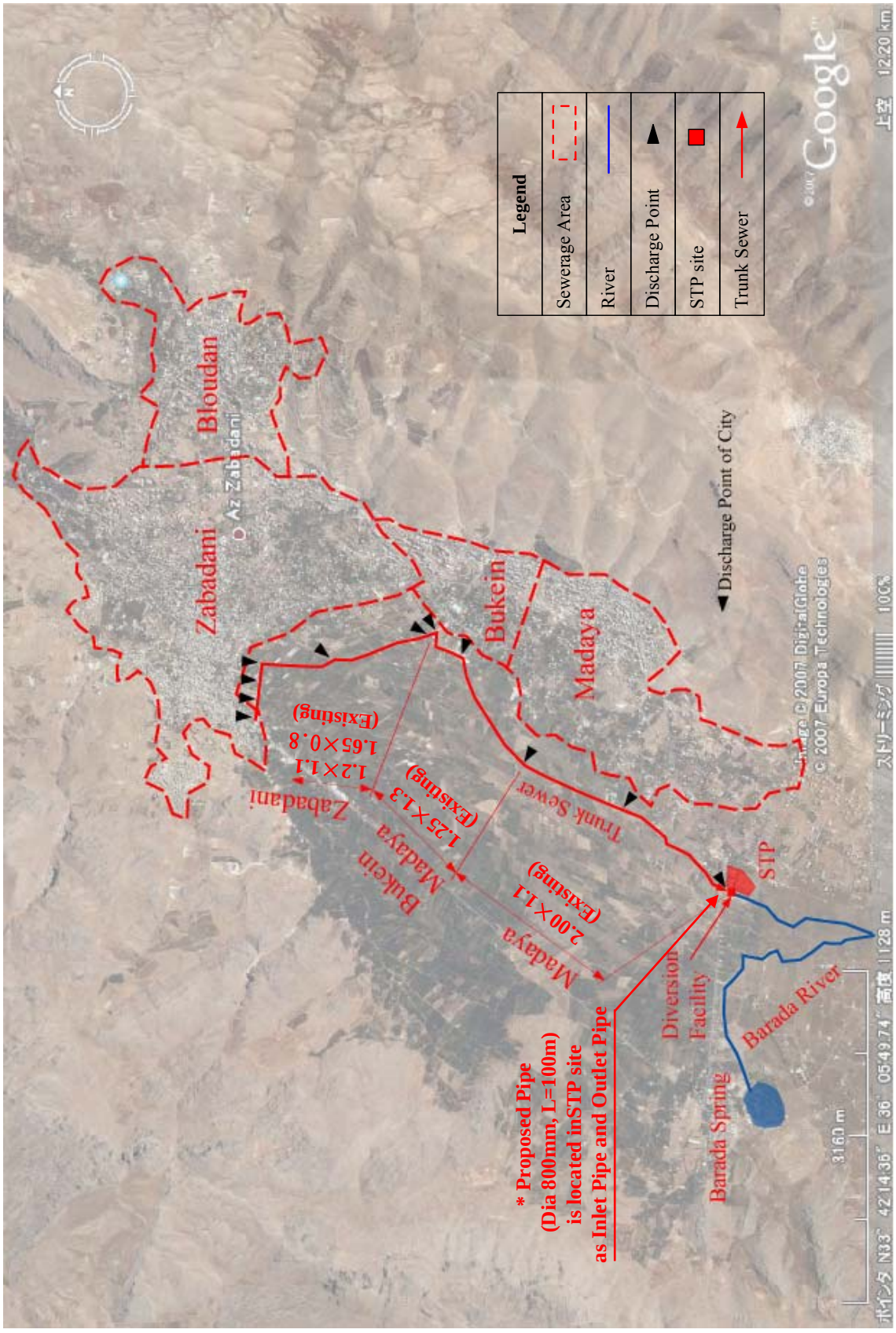


Figure 1.1.1 Sewerage Planning Map

1.1.5 Summary of Design Fundamentals on Sewerage System Development Plan

The population, wastewater flow and other design fundamentals are summarized in **Table 1.1.5**.

Table 1.1.5 Summary of Design Fundamentals

Items	Unit	F/S		M/P	
Target year		2015		2025	
Service Population	person	48,300		53,500	
Daily Average Wastewater Flow	m^3/day	18,250		22,201	
Reaction Tank	No	9		10	
Treatment Method		Oxidation Ditch Method		Oxidation Ditch Method	
Discharge Pint		Barada River via Conduit		Barada River via Conduit	
Wastewater Quality		Incoming	Effluent	Incoming	Effluent
BOD	mg/l	310	30	310	30
SS	mg/l	360	30	360	30

1.2 Design of Sewerage Facilities

1.2.1 Population and Wastewater Flow Projection

(1) Population Projection

National census was utilized for population projection as it is most reliable population data available. Although national census was performed on the year of 1981, 1994 and 2004, population data classified into administrative units such as City, Town, Village and Municipality is only available in the investigation conducted on 1994 and 2004. Based on these two population data, average population growth rate was calculated.

Compared the population growth ratio calculated by total Governorate population between two time periods, namely 1981-1994 and 1994-2004, the later has lower ratio. There is restriction on population growth.

As excessive population was calculated by constant population growth rate, the JICA Study Team applied reduction ratio to population growth rate in order to attain proper future population. Based on the said two section population data, reduction ratio was set by 80% per five years. The population projection of each city is shown in **Table 1.2.1**.

Table 1.2.1 Population Projection

(Unit : Person)

District	Sub -district	City & Town	1994	2004	2010	2015	2020	2025	Annual Growth Rate (%)
Zabadani	Zabadani	Zabadani	21,049	26,285	30,000	32,800	35,200	37,300	2.25
		Bloudan	4,685	3,101	3,300	3,400	3,500	3,600	1.00
	Madaya	Bukein	1,746	1,866	1,900	2,000	2,000	2,000	0.67
		Madaya	8,649	9,371	9,800	10,100	10,400	10,600	0.80
Total			36,129	40,623	45,000	48,300	51,100	53,500	

(2) Wastewater Flow Projection

As aforementioned, numerous tourists visit Zabadani during summer season, wastewater flow increases remarkably in this season. Based on EIB Study, the JICA Study Team set the rate of anticipated tourist wastewater flow against domestic wastewater flow as indicated in **Table 1.1.1**. Projected wastewater flow is shown in **Table 1.2.2**. Per capita wastewater rate-1 was calculated by "non-domestic ratio" of 0.3, while per capita wastewater rate-2 was reckoned by "non-domestic ratio" of 0.1.

Table 1.2.2 Projection of Wastewater Flow

City	Item		Unit	2004	2010	2015	2020	2025
Zabadani		Population	per.	26,285	30,000	32,800	35,200	37,300
	per capita wastewater rate-1	Average	LCD	129	135	142	148	155
		Daily max		150	157	165	172	180
		Hourly max		250	262	275	287	300
	Tourist		%	200	200	200	200	200
	Generated wastewater (pcwr-1)	Average	m^3/day	10,169	12,187	13,959	15,661	17,317
		Daily max		11,809	14,152	16,210	18,187	20,110
		Hourly max		19,682	23,587	27,017	30,311	33,516
	per capita wastewater rate-2	Average	LCD	109	115	120	125	131
		Daily max		127	133	139	146	152
		Hourly max		211	222	232	243	253
Bloudan		Population	per.	3,101	3,300	3,400	3,500	3,600
	Tourist		%	300	300	300	300	300
	Generated wastewater (pcwr-2)	Average	m^3/day	1,354	1,512	1,632	1,757	1,886
		Daily max		1,572	1,756	1,896	2,040	2,190
		Hourly max		2,620	2,927	3,160	3,400	3,650
Bukein		Population	per.	1,866	1,900	2,000	2,000	2,000
	Tourist		%	250	250	250	250	250
	Generated wastewater (pcwr-2)	Average	m^3/day	713	762	840	878	917
		Daily max		828	885	976	1,020	1,064
		Hourly max		1,379	1,475	1,626	1,700	1,774
Madaya		Population	per.	9,371	9,800	10,100	10,400	10,600
	Tourist		%	50	50	50	50	50
	Generated wastewater (pcwr-2)	Average	m^3/day	1,534	1,684	1,818	1,958	2,082
		Daily max		1,781	1,956	2,112	2,273	2,418
		Hourly max		2,969	3,260	3,520	3,789	4,030
Total		Population	per.	40,623	45,000	48,300	51,100	53,500
	Generated wastewater	Average	m^3/day	13,769	16,145	18,250	20,254	22,201
		Daily max		15,990	18,749	21,193	23,520	25,782
		Hourly max		26,650	31,249	35,322	39,201	42,970

Note) (pcwr-1) means "per capita Wastewater rate-1", while (pcwr-2) means "per capita Wastewater rate-2"

1.2.2 Sewage Collection System

As sewer network has already been developed and though odor mitigation is on-going, trunk sewer has been completed, only remaining collection system to be designed by F/S is diversion facility and truck sewer to transfer the diverted wastewater to STP. This facility converts whole dry weather wastewater to STP and separates some portion of wet weather wastewater to STP. Refer to **Figure 1.2.1**.

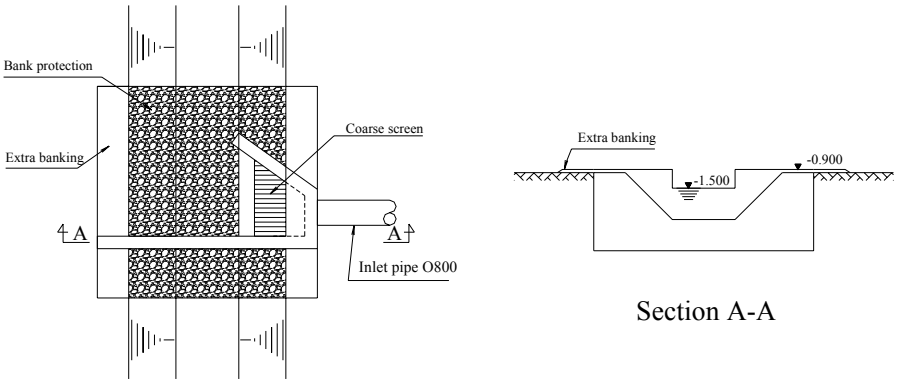


Figure1.2.1 Outline of Diversion Facility

In case of wet weather, some portion of wastewater is overflows the weir and discharged to Barada River. However, pollution load contained in this overflowed wastewater is quite small compared that contained in dry weather wastewater and natural purification action of Barada River is also expected. Stop log is planned to control this overflow wastewater volume.

Wastewater is converted by the weir to pit and then transferred to STP by inlet trunk. Refer to **Figure1.2.2**.

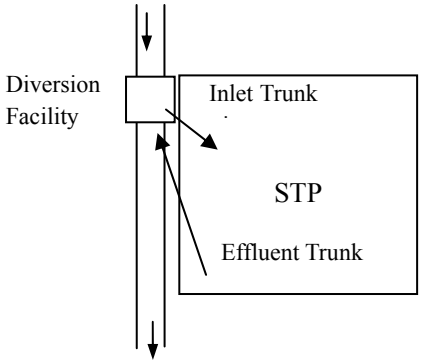


Figure 1.2.2 Layout of Diversion Facility and STP

As incoming volume of storm water is unknown at this moment. In detailed storm water analysis, its effluent volume is calculated based on collection area by each section of sewer pipes according to rainfall intensity formula and storm water flow formula. Due to the study period restriction, the JICA Study Team couldn't afford such detailed analysis. As stated earlier, treatment of whole wet weather wastewater is not applicable, as its volume is expected to be huge. So some "portion" of wet weather wastewater shall be treated in STP. The Team proposed that volume ratio of wet weather wastewater to be treated is two times of dry weather wastewater. **Table 1.2.3** shows the specification of proposed trunk sewer:

Table 1.2.3 Specification of Proposed Trunk Sewer

Wastewater Flow		Proposed Capacity	Diameter	Slope	Velocity	Pipe Capacity
m^3/day	m^3/s	m^3/s	mm	‰	m/s	m^3/s
42,970	0.497	0.994	800	3.4	1.99	1.002
Dry Weather Flow		$2Q_{DWF}$				$2Q_{DWF}$

Treated wastewater was planned to send to just downstream of diversion facility to secure constant flow in the conduit.

1.2.3 Sewage Treatment Plant

(1) Basic Conditions for the Design of Sewage Treatment Facilities

1) Basic data from M/P

The basic conditions for the design of sewage treatment facilities are presented in **Table 1.2.4**.

Table 1.2.4 Basic Conditions for the Design of Zabadani STP

Items	unit	M/P	Stage 1
Target year		2025	2015
Treatment Method		Oxidation Ditch	
Design flow Q_1(Daily Average) for main treatment facilities	m^3/d	22,201	18,250
Design flow Q_2 (Hourly Max) for Pump and UV	m^3/d	42,970	35,322
Available land area	m^2	62,400	
Wastewater quality		BOD	SS
Incoming	mg/l	310	360
Effluent	mg/l	30	30

Note) UV = Ultra Violet Radiation Equipment

2) Review of Treatment Method on M/P

The optimum processes in Syria were selected out of the general methods based on the recent studies and required conditions upon designing. Especially the methods required complicated O&M or affected by winter temperature, were not emplyed. Applicable methods were as

follows:

a) Conventional Activated Sludge Method
b) Conventional extended aeration Method
c) Oxidation Ditch Method (one of Extended Aeration Method)
d) Constructed Wet Land Method
e) Submerged Attached Growth Method

The features of these methods showed **Table 1.2.5**

Applicable treatment methods in Zabadani are Conventional Extended Aeration, Conventional Activated Sludge, and OD judging based on the amount of sewage flow. These methods enable facility layout within the proposed land for STP construction. Special consideration shall be paid to secure the possibility of re-use of treated sewage and the topographical feature of closed groundwater body in Rural Damascus Governorate where contamination of groundwater is apt to advance by accumulated nitrogen compound.

In case of Conventional Extended Aeration method, though nitrification will advance, removal rate of T-N is low, and thus nitrogen concentration in groundwater will increase. The effect is similar in case of Conventional Activated Sludge method. Therefore, the Study Team would like to propose OD because de-nitrification is available and O&M is easy if this method is applied. **Table 1.2.6** shows the overall comparison of these methods. OD method has many advantages.

Concerned about re-use of treated sewage for agricultural irrigation, disinfection method by UV would be desirable as desired by regional officer and referred to relevant study .

Table 1.2.5 The features of Applicable Methods

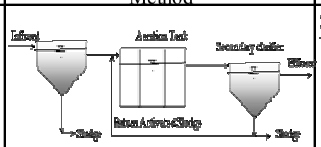
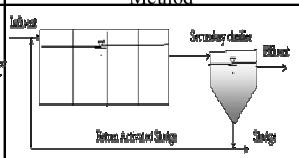
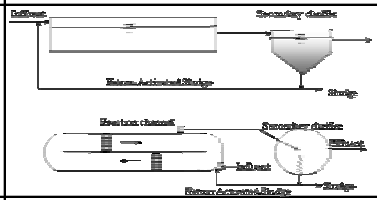
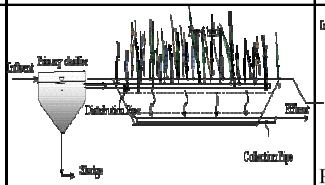
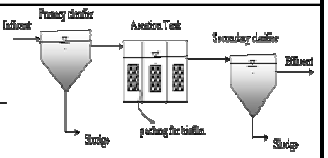
	Conventional Activated Sludge Method	Conventional extended aeration Method	Oxidation Ditch Method	Constructed Wet Land Method	Submerged Attached Growth Method
Schematic Drawing					 Primary clarifier can be omitted in
Process	This is the most basic Activated Sludge Method. Settled sewage and return activated sludge (RAS) are mixed and aerated by diffused air or mechanical aeration equipment through several compartments. Organic matter would be absorbed and consumed by activated sludge. Finally, the increased flocculated sludge solid are separated in secondary settling tank.	This is one of Activated Sludge Methods. As the primary settlement is omitted, high concentration of organic matter is biologically treated and therefore, the aeration tank becomes larger, approximately three times of that of conventional activated sludge method.	This is also another type of Activated Sludge Methods, one of Extended Aeration Method. Reactor is oval-shaped channel and equipped with aeration device. Sewage is passed through screen and grit removal chamber and subsequently enters the reactors, and is aerated and circulated with RAS for long time, and finally increased flocculated sludge solid are separated in secondary settling tank.	Constructed Wet Land Method is simple and elegant method applying self-purification capacity of reedy grass. Constructed Wet land Method consists of reed bed and primary sedimentation tank which reduce the load on reed bed for fermentation of organic matter. Disinfection is not required.	This is one of attached growth methods applying package of bio-film (generally plastic media). As the bio-film is submerged in aeration tank, organic matters will be absorbed on biological layer grown on the surface of film through metabolism.
Features	This method is suitable for large-scale treatment plant that requires highly stable performance of treated sewage quality and has compact site area. On the other hand, construction cost and O&M expenditure are relatively higher than other methods because this method needs many experienced operators, daily inspection of equipment, treatment of sludge generated in both primary and secondary clarifiers, and so on.	- This method consumes large power, but generates small amount of sludge. Therefore it's applicable for small-scale plant. - O&M is relatively easy but it is rather difficult to control air volume and RAS according to the concentration of incoming sewage to avoid disorganization of activated sludge due to over-aeration. - Less odor - Quantity of excess waste sludge is small and stable in fermentation of organic matter.	- Performance of treatment is stable because of low-loaded operation and exquisite allocation of aerobic zone and anaerobic zone. As O&M is very easy, if mobilization of operator is difficult or skilful operator is not available in local branch of Ministry in charge, OD could be a better solution. - Nitrification and denitrification could be carried out using This process. - Less odor - in case of combined sewer system, diluted sewage by rain does not harm biological process. - Quantity of excess waste sludge is small and stable in fermentation of organic matter. - Aeration Time is long though, construction cost is almost same As other process.	As this system is simple, its O&M is very easy and construction cost and O&M expenditure are very small. However, this process requires vast land. So this method is suitable for rural town where vast land is available and population is small.	- O&M is easy because no RAS is needed. - By selection of materials with larger surface area for bio-film, treatment would be flexible to fluctuations of incoming sewage flow and organic load. - Bio-film might cause clogging by enlarged biological layer if the plant is operated under higher loading condition. - Quantity of excess sludge is very small and stable in fermentation of organic matter.

Table 1.2.6 Comparison of Treatment Processes

Evaluation Factor	OD	Conventional extended aeration	Conventional Activated Sludge
Land Availability; Land for plant expansion shall be secured to cope with future growth of incoming sewage flow or plant upgrading.	+	+	+
Nitrification; Removal efficiency of NH_3-N	+	++	+
Denitrification; Removal efficiency of T-N corresponding to groundwater pollution	++		
Re-use for Irrigation; As purpose of treated sewage re-use is mostly irrigation use, treatment method which denitrification is desired and with long retention time would be preferred.	++	+	
Correspondence to load fluctuation; Method with long retention time would be preferred to cover the O&M activities during peak flow time, and to enable stable operations and reliable performance, as the peak flow occurs once a day between 5:30 pm and 9:30 pm, after duty hours.	++	+	
Sludge Reduction; Small sludge volume is preferable on O&M	+	+	
Odor Problem; Since the sources of odors are on incoming wastewater, discarded waste (grit, screenings and sludge), anaerobic stabilization pond, anaerobic sludge digester, sludge thickening tank and primary sedimentation tank, treatment method with less these facilities would be preferred.	+	+	
Simple equipment; Technically complicated system is not applicable due to shortage of manpower on O&M. Simpler system should be composed.	++	+	
Easiness of operation; Simpler equipment realizes easy maintenance.	++	+	
Construction cost; Include sludge treatment & disposal facilities		+	
Maintenance cost;	++	+	
Evaluation	16 points	11 points	2 points

3) Verification of Basic Conditions

Regarding to design flow, the JICA Study Team visited the site several times and observed the followings;

- As Zabadani is well-known tourist spot, there must be seasonal fluctuation in wastewater flow,
- As abundant flow with enough velocity was observed in open channel and outlet pipes every time, no sediment in trunk sewer is expected,

Based on the wastewater flow and quality survey conducted by the JICA Study Team, BOD was 290 mg/l when flow was 16,000 m^3/day. Refer to **Table 1.2.7.**

Table 1.2.7 Wastewater Flow/Quality and Treatment Indicator

Items	Actual Measurement	Design flow		Remark
		Q_1	Q_2	
Flow (m^3/d)	16,000	22,201	42,970	$Q_1=Q_{DA}$, $Q_2=Q_{HM}$
BOD (mg/l)	290	310	160	
SS (mg/l)	272	360	186	
BOD-SS Loading of OD (kg-BOD/kg-SS・D)	0.027	0.039	0.039	Japanese standard 0.03 to 0.05 Metcalf & Eddy 0.04 to 0.1
Retention Time of OD (hr)	62	44	24	

Note) Actual Measurement was conducted by the JICA Study Team from 10:00 to 12:00 on 11th Nov.2007

Providing that pollution loading is constant and hourly maximum flow is constant, incoming BOD concentration was calculated as 160 mg/l and BOD-SS loading in Oxidation ditch was reckoned as 0.039 (kg-BOD/kg-SS・D) corresponding to the Japanese standard and American standard shown in the guideline issued by Metcalf & Eddy. This is why capacity of OD is determined by BOD pollution loading. Therefore, even incoming wastewater flow was fluctuated, STP will have stable treatment function. Thus, appropriateness of basic condition in **Table 1.2.7** was verified.

4) Treatment of Combined Sewage

As aforementioned, no sediment at bottom of sewer pipe or open channel is expected due to abundant flow and sufficient velocity, when generated wastewater flow exceeds design flow, wastewater quality becomes lower than design quality. Therefore OD can hourly maximum flow ($1.94 \cdot Q_1$). This also means that treatment performance will be stable against wet weather wastewater flow which was set by $2 \cdot Q_1$. However, further detailed quality and quantity survey on combined wastewater is favorable to attain more reliable STP design in detail design stage.

In Japan, wet weather wastewater generated in early stage of raining is generally stored for subsequent secondary treatment as thick wastewater is usually created in early stage. Behavior of wet weather wastewater was only confirmed by this Study and once in Hassakeh as shown in **Figure 5.2.3** in Main Report of M/P. Therefore, further detailed quality and quantity survey on combined wastewater is favorable to attain more reliable STP design in detail design stage.

(2) STP Land Acquisition Status and Necessity of Odor Control

STP land is public land owned by Ministry of Agriculture located in farm area. Proposed STP site is advantageous for the followings:

- As proposed STP site is adjoining to the existing trunk sewer, less length of additional trunk sewer to convey wastewater to STP is needed
- As it is located in farming area, it convenient for re-use of treated wastewater in agricultural purpose.

For the sustainable development of Zabadani as tourist spot through the future, wastewater treatment is essential and as STP land is located in farm area, odor control is necessary. Refer to Appendix 3.1 as to the detail of odor control. It was summarized as follows:

- Countermeasures at the planning phase
  a) Select the treatment method generates less offensive odor
  b) Shorten additional trunk sewer to keep wastewater fresh
  c) Allocate odor generating facilities properly to prevent odor dispersing to outside
  d) Secure land for deodorization facility might be planned in the future

- At the O&M phase, plan and apply suitable deodorization method after measurement of odor intense at target facilities.

(3) Site Condition

Plane table survey was conducted to measure the land area and ground level of the proposed Zabadani STP construction site. As present ground elevation looks lower compared with road elevation, design STP ground elevation shall be set at +0.500m, 0.5m higher than road level± 0.000. Refer to **Table 1.2.8** and **Figure 1.2.3** as to site conditions.

Table 1.2.8 Conditions of proposed STP Construction Site

Items	Unit	Figure	Remarks
Land Area	m^2	62,400	
Present Ground Elevation	m	－1.000	
Road Elevation	m	±0.000	Public road front of STP
Wastewater Surface Elevation	m	－1.370	36m away from the public road
Design STP Ground Elevation	m	+0.500	

Note) “Elevation” means the height from the base point on front approach road.

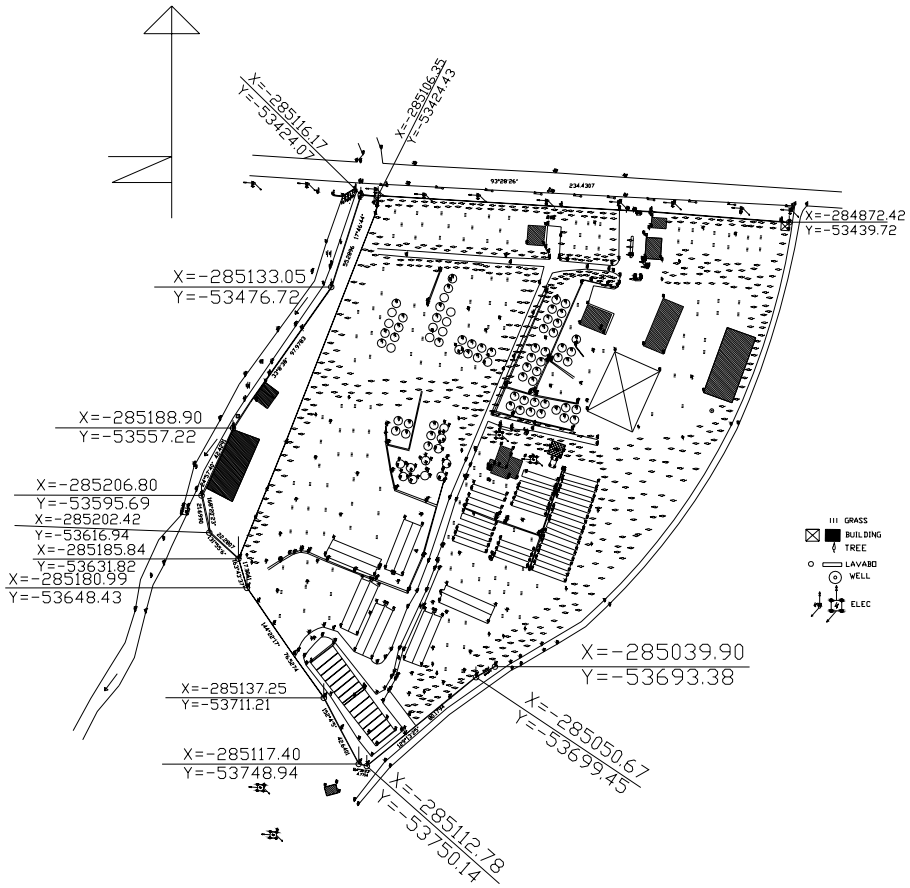


Figure 1.2.3 Present Map of STP

(4) Hydraulic Profile of STP

Hydraulic profile was prepared in order to set the design conditions as follows:

- Ensure adequate hydraulic gradient for wastewater to flow through the treatment facilities by gravity. Appropriate connecting pipe diameter was determined.
- Set the required pump head
- Prevent overflow in proposed facilities might be caused by the raised water level of Barada River during rainy days

Typical range of head losses through respective treatment facilities are given in **Table 1.2.9**.

Table 1.2.9 Typical Head Losses across various Unit

Treatment Unit	Head Loss Range (m)
Bar Screen	0.15 — 0.30
Grit Chamber	0.45 — 0.90
Aeration Tank	0.21 — 0.60
Secondary Settling Tank	0.45 — 0.90
Disinfection Tank	0.21 — 1.80

Source) Wastewater Engineering, Metcalf & Eddy, Third Edition

(5) Facility Layout Plan

Facility layout plan shown in **Figure 1.2.4** was prepared considering the followings:

- As existing trunk sewer is located in the west side of STP site, screen grit removal channel and inlet pumping station was planned in north-west and disinfection tank and effluent pipe was planned in south-east.
- For proper and efficient odor control, appropriate sludge treatment method shall be selected since sludge treatment process is the strongest offensive odor source. In this regard, mechanical sludge dewatering method was proposed. Only little odor will be emitted due to prompt treatment. However, as gravity sludge thickening tank was employed, odor will be emitted from this tank. So, these facilities shall be placed in the center of the site and be concealed by fragrant plants.
- Reactor tanks are pluralized due to operating practices. Necessary number of tanks will be operated based on inflowing wastewater quantity and quality. Distribution tank was allocated.
- Shatter-resistant planting against offensive odor is allocated at outer circumference of facilities. Fragrant plant is preferable. Planting will also offer good landscape.
- Space shall be secured for storage facility of thick combined wastewater generated during early stage of raining. This is future plan for further pollution elimination. It shall be allocated near to PS.

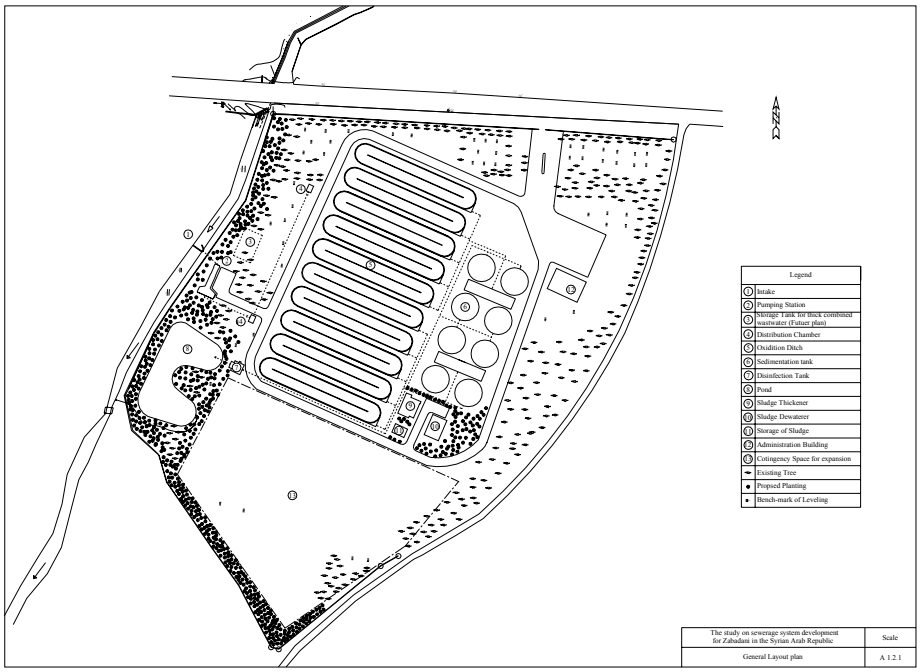


Figure 1.2.4 Facility Layout Plan

(6) Proposed Facilities

The facilities summarized in **Table 1.2.10** are proposed considering the following aspects.

- Since inlet water level is relatively high, screen, grit removal channel and pump room shall be integrated in one structure as shown in **Figure 1.2.5**.

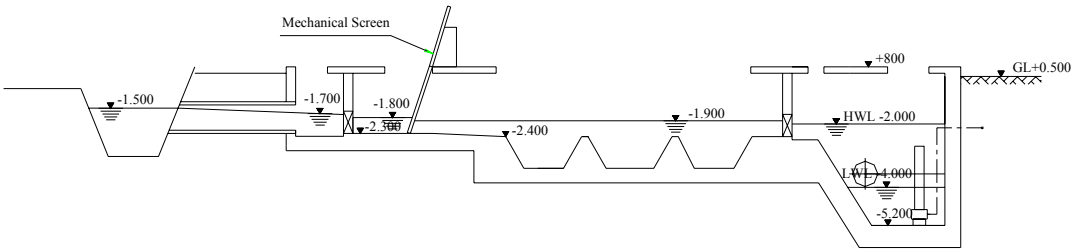


Figure 1.2.5 Profile of Inlet to Pump Chamber

- Oval-shaped OD channel are pluralized aiming flexible operation. Totally, 10 numbers of channels are allocated. For reference, reactor operation for de-nitrification is generally done as follows:
  a) Keep optimum MLSS by regulations of RAS, Return Activated Sludge
  b) Withdraw the excess sludge
  c) Regulate aeration time

  Since ten channels were planned, optimum de-nitrification can be realized by control in operation channel number. Ten tanks shall be divided in two series as shown in **Figure 1.2.6** by two independent distribution tanks served for each series of channels.

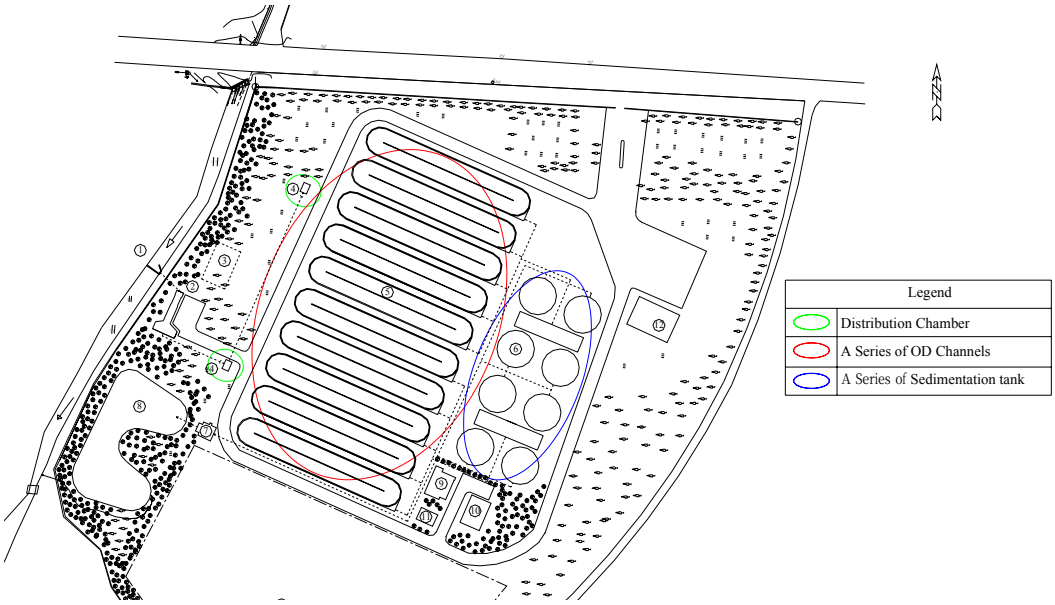
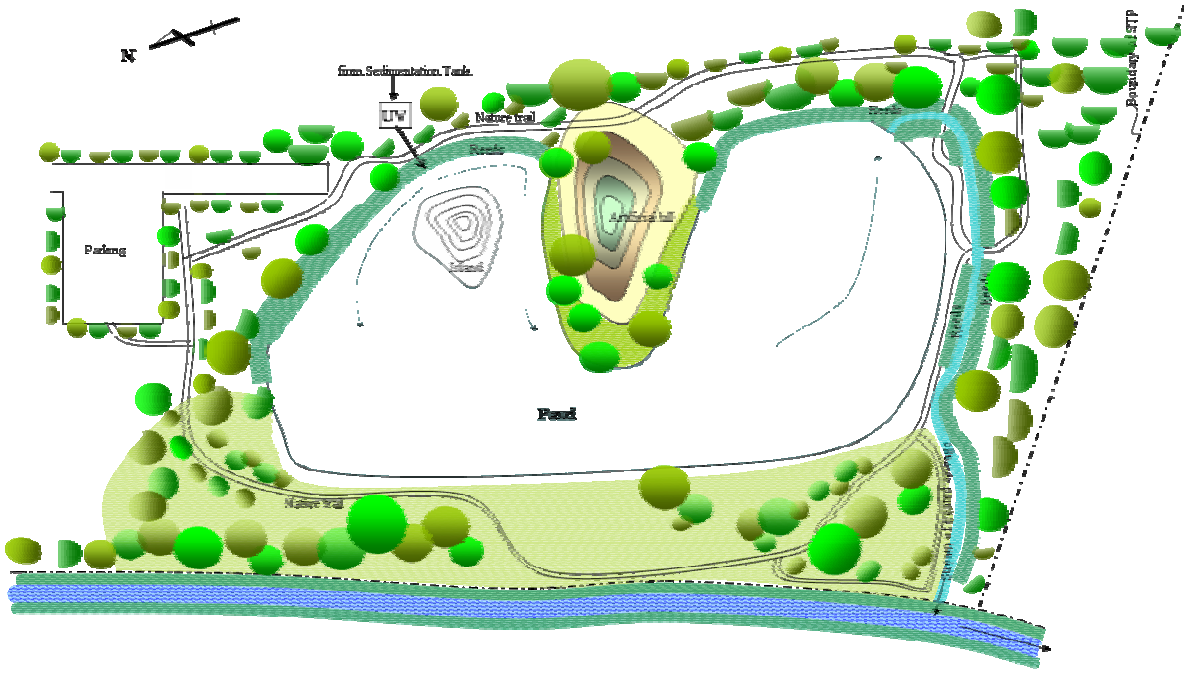


Figure 1.2.6 Layout of Distribution Tanks and Series of Treatment Facilities

- Eight sedimentation tanks were divided in two series as indicated in **Figure 1.2.6**. Two distribution tanks and two RAS rooms are allocated.
- Two disinfection tanks are planned. Disinfection method is UV to contribute agricultural re-use of treated wastewater.
- As current effluent standard is too strict against NH_3-N concentration, stabilization pond for treated wastewater is planned just upstream of effluent pipe for safety. Shallow pond supply oxygen to water and NH_3-N would be stabilized to NO_3-N. Retention time can be secured more than 12 hours. This also serves as landscape pond. Fish would be released in it as biotope assembles all kind of creatures and plants. This pond is of help to environmental education on public education and publicity campaign against negative image to STP.



-

Figure 1.2.7 Pond for Polishing Water and Biotope

- Two Gravity Sludge Thickeners as the plan of **Figure 1.2.8** are placed mainly for purpose of sludge reservation.

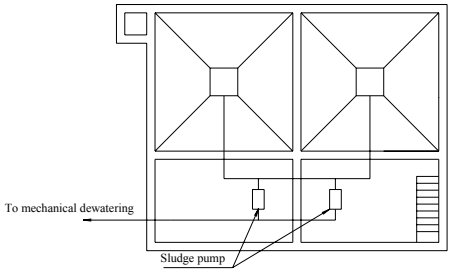


Figure 1.2.8 Plan of Gravity Sludge Thickener

- Two mechanical sludge dehydrator were proposed. As sludge will be treated

promptly in fresh condition, less odor will be emitted so neighboring residents will never annoyed by offensive odor. Refer to **Figure 1.2.9**.

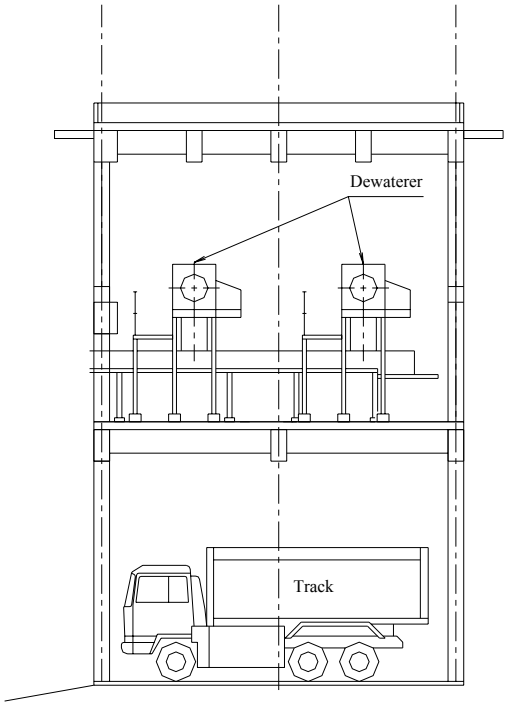


Figure 1.2.9 Section of the house of Mechanical Sludge Dehydrator

Summary of proposed facilities is shown in **Table 1.2.10**.

Table 1.2.10 Summary of Proposed Facilities

Items	M/P	F/S
Grit Chamber (No.-W×L)	2-1.6m×8m	2-1.6m×8m
Main Pump (No.-D×power)	5(1)-φ250mm×15kw	5(1)-φ250mm×15kw
Reactor (No.-W×L×H)	10-5.5m×150.0m×3m	9-5.5m×150.0m×5m
Final Sedimentation Tank	8-φ18m×3.5m	7-φ18m×3.5m
Disinfection Channel	3-1.5m×3.5m×0.8m	3-1.5m×3.5m×0.8m
Gravity Sludge Thickener	2-6.0m×6.0m	2-6.0m×6.0m
Mechanical Dewatering Unit	2-30m^3/hr	2-30m^3/hr

Note) W = Width, L = Length, D = Diameter, H = Height

CHAPTER 2 CONSTRUCTION PLAN AND PROCUREMENT PLAN

2.1 Construction Plan

2.1.1 Outline of the Construction

(1) Stage of the project

Zabadani project is planned to be implemented two stages based on the design target years of 2015 (Stage-I) for the feasibility study (F/S), 2025 (Stage-II) for the Master Plan (M/P).

Stage-I is an urgent and priority project, and is expected to start operation from 2013.

Table 2.1.1 Staging of the Project

Parameter	Stage-I (F/S)	Stage-II (M/P)
Target Year	2015	2025
Capacity of STP	18,500 m^3/day	22,200 m^3/day

(2) Construction components for Stage-I (F/S)

Construction is carried out for facilities of Stage-I (F/S).

1) STP (Oxidation ditch method)

The contents of construction in a stage-I are shown in **Table 2.1.2**.

Table 2.1.2 Contents of Construction for STP

Facility	Stage-I [2015] (18,500 m^3/day)	Stage-II [2025] (22,200 m^3/day)
Pumping station Dia. 250mm	5/5 units	―
Oxidation ditch tank	9/10 basins	1/10 basins
Sedimentation tank	7/8 basins	1/8 basin
Disinfection channel	1 unit	―
Sludge thickener	2/2 basins	―
Sludge dewatering	2/2 units	―
Generator	1 unit	―

2) Pipes (Trunk sewer)

Dia. 800mm (HDPE), L=100 m

2.1.2 Condition for the Construction

Main conditions for construction of STP are shown below.

Location	:	Zabadani area
Site	:	Area approx. 5.5 ha
		Ground Level +1,198.7 m(present),
		+1,200.5 m(plan)
		Groundwater Level GL-4.3 m
		Supporting layer +GL-5.0 m (Gravel layer)
		N-value more than 50
Existing Facility	:	Existence (Removal required)
Approach Road	:	Existence (North side of the site)
Foundation type*	:	Spread foundation
Method of Earth retaining*	:	Nonuse (Open cut Excavation)

* Foundation type and Method of earth retaining are assumption in the present condition. A detailed examination is required in the D/D stage.

2.1.3 Construction Schedule

Construction of STP and pipe for stage-I is carried out for about three years from 2010 to 2012. Construction schedule is shown in **Table 2.1.3**.

Table 2.1.3 Construction Schedule for Stage-I

	2008	2009	2010	2011	2012	2013	2014	2015
1. Pre-Construction Stage	←	———	→					
1). Preparation of project	▪▪▪▪▪							
2). Pre-Construction (D/D, PQ, Tender)		▪▪▪▪▪▪▪						
2. Construction Stage			←	———	———	→		
1). Civil and Building Works								
a. Preparation of Construction			▪▪					
b. Removal of Existing Facility			▪▪					
c. Structural Construction			▪▪▪▪▪▪▪▪▪▪					
d. Trunk Sewer					▪▪▪▪			
2). M&E Works								
a. As-build Drawing, Manufacturing				▪▪▪▪▪▪				
b. Installation					▪▪▪			
3). Commissioning, Turn-over					▪▪			
3. O&M Stage						———	———	→

2.2 Procurement Plan

2.2.1 Land Acquisition Plan for Sewerage Treatment Plant

The site planned construction for STP is a public land owned by ministry of agriculture (Ministry of defense is using it now).
Since deliberations are already made among relevant ministries, land acquisition will not be difficult.

2.2.2 Procurement Plan for Construction Materials and Equipment

The construction materials necessary for the project shall be procured in Syria to the greatest extent possible. However, construction materials that are not available in the country, cannot meet the quality or specifications of the design requirements, or cannot be reliably procured with regard to distribution volume, shall be procured from other countries. The following summarizes a procurement plan for the project.

(1) Sand, Gravel, Concrete, Form , Brick
These materials are easily procured in Syria since they are manufactured in the country.

(2) Reinforcement Bar
Reinforcement Bar can be procured in Syria. However, they cannot meet the quality or specifications of the public works such as sewerage project reason for the lack of tensile strength. Reinforcement Bar must be imported from other countries.

(3) Pipe
High Density Polyethylene (HDPE) pipe, which will be used in this project, are easily procured in Syria since they are manufactured in the country. HDPE pipe and Polyvinyl Chloride (PVC) pipe are manufactured in Syria.

(4) Mechanical and Electrical Equipment
Major mechanical and electrical equipment such as pumps, aerator, sludge collector, dewatering machine, control panels and power receiving/transforming equipment are not produced in Syria. This equipment must be imported from other countries.

(5) Construction Machinery
Construction Machinery, such as backhoes, dump trucks, crane trucks can be leased in Syria.

Component division of foreign and local portion is shown in **Table 4.2.1**.

Table 2.2.1 Component Division of Foreign and Local Portion

Item	Material	Foreign Portion	Local Portion
(1) Civil Works	Labor		○
	Sand, Gravel		○
	Concrete		○
	Form		○
	Reinforcement Bar	○	
(2) Pipe	HDPE		○
(3) Mechanical & Erectrical Equipment	Pump, Aerator, Sludge Collector, Dewatering Machine, etc	○	
(4) Construction Machinery			○
(5) Building Works	Brick		○
	Indoor Materials		○

CHAPTER 3 OPERATION AND MAINTENANCE PLAN

3.1 Organizational Strengthening of Sewerage Sector

3.1.1 Summary of the Current Organization

The general task of Rural Damascus Water Supply and Sewerage Authority (RDAWSSA) is to ensure adequate water supply and sanitation services in Rural Damascus Governorate. In particular, it is involved in planning, implementing and operating new projects, as well as maintaining the existing facilities.

Also, there is a Prime Minister Decision to set up the Rural Damascus Sewerage Company under RDAWSSA. However, this Decision has not been implemented in practice yet (as of November 2007). Establishment of the Company appears to be a lengthy procedure because it entails transferring of assets (existing sewers) from the municipality to the Company, as well as recruiting a significant number of personnel. Therefore, it is RDAWSSA who is currently responsible for sanitation services across the Governorate, including the F/S area. According to RDAWSSA, it may take several years to complete setting up the new Company once it becomes necessary. An organization structure of the new Company is not finalized yet; however, it is not expected that it will differ significantly from the structure of the already existing sewerage companies.

RDAWSSA is headed by the Board and divided into 12 Directorates: (1) Directorate for administration, legal affairs and human resources, (2) Directorate for planning and statistics, (3) Directorate for interior supervision, (4) Directorate for designs and studies for the water supply and wastewater projects, (5) Directorate for checking and execution, (6) Directorate for investment and maintenance for water supply and wastewater projects, (7) Directorate for subscribers' affairs, (8) Directorate for financial affairs, (9) Directorate for calculations, (10) Directorate for qualifying, training and scientific research, (11) Directorate for information and technology, and (12) Directorate for Economic Units. Also, new companies may be established under the existing structure of RDAWSSA, e.g. the Sewerage Company. The General Director is the top executive of RDAWSSA. The total number of RDAWSSA staff is approximately 2,070.

The entire service area of RDAWSSA is covered by about 40 Economic Units (branches), which are in charge of services within their respective areas. Particularly for the F/S area, there are Economic Units operating in Zabadani, Bloudan and Madaya (also covers Bukein).

Refer to M/P Report, Chapter 4 for further details about the existing institutional and organizational framework of the sewerage sector.

3.1.2 Proposed Organization Structure

The proposed organization structure for the project implementation and for the subsequent O&M, is discussed in details in Chapter 10 of the M/P Report and summarized below:

(1) Project implementation stage (project preparation, pre-construction and construction)

At the project implementation stage, a Project Management Unit (PMU) is supposed to be established under RDAWSSA, which would be responsible for execution of all on-gong capital projects of RDAWSSA, regardless the source of funding (by international donors or/and by the Government of Syria). The PMU could be formed on the basis of several relevant Directorates of RDAWSSA such as Directorate for design and studies, Directorate for checking and execution, Directorate for investment and maintenance, and so on.

The main tasks of the PMU could be for example: (a) Communication, reporting and representation activity with funding agencies; (b) Coordination and negotiations with relevant organizations; (c) Reporting to the Government of Syria; (d) Obtaining necessary approvals and permits; (e) Undertaking all the process for selection of consultants; (f) Undertaking all the process necessary for selection of contractors; (g) Monitor daily activities; (h) Disbursement requests and financial control of the payments; (j) Environmental control of ongoing activities, (k) Public relations and public awareness activities, and so on.

The PMU should be assisted by the selected Consultants in preparing design and tender documents, procuring goods and services, executing construction supervision, financial management, etc. A Steering Committee should be also established to facilitate the F/S project implementation.

(2) O&M stage

At the O&M stage, results of the F/S project implementation are supposed to be transferred for O&M to the above-discussed Sewerage Company, which will manage all matters relating to O&M of the sewerage system. Details of the organization structure proposed for O&M of the F/S project in Zabadani area are provided in the next section.

However, the capacity of the Sewerage Company’s staff should be sufficient to cope with the required tasks and volume of work for O&M of the proposed new sewerage facilities. The capacity building issues are addressed in Chapter 3.2.

It is crucial that the envisaged PMU and the Sewerage Company under RDAWSSA are established timely. For successful implementation of the F/S project, the PMU should be established not later than by the beginning of construction (in 2008). For sound O&M of the sewerage system, the Company should become functioning not later than by the end of the construction stage (2012). On the other hand, setting up the PMU and the Company is recommended to be completed as early as possible in order to have sufficient time to build capacity of the PMU and the Company staff.

3.1.3 Details of the Proposed Organization Structure for O&M

(1) Organization Structure

The following **Figure 3.1.1** shows the proposed organization structure of the Sewerage Operations Center, which should be established by the Sewerage Company in Zabadani area for O&M of the project upon its completion.

The Sewerage Operations Center is proposed to consist of two main sections: the Sewage Treatment Plant (STP) Section and the Sewage Collection Section and assisted by the GIS Section. The required manpower in each section is shown in the Figure. RDAWSSA has to secure the necessary staff, mostly by recruiting them from the outside in order to ensure the proper operation.

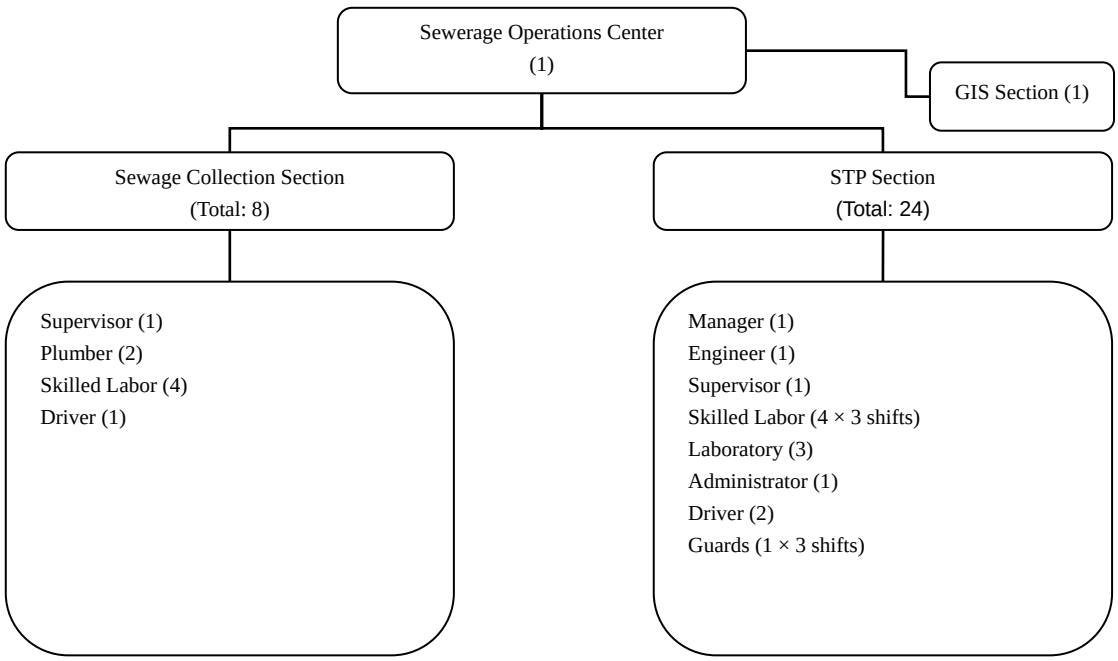


Figure 3.1.1 Proposed Organization Structure of Sewerage Operations Center in Zabadani

The above-proposed structure is expected to be expanded to cover other areas and therefore other Operations Centers are expected to be established under the Sewerage Company.

(2) Duties and Staffing of the STP Section

The works to be carried out by the STP Section are as follows: (i) daily operation of STP; (ii) regular maintenance of STP (to be contracted out, when necessary); (iii) daily inspection of the STP's condition; (iv) quality control; (v) daily recording of influent sewage volume for each STP; (vi) daily removal of grit and screenings from pretreatment facilities; (vii) daily withdrawal of sludge from sedimentation tanks; (viii) processing of sludge and disposal of dried sludge.

The STP is proposed to be operated in three shifts by 24 employees in total. The Section will be apparently located at the STP site.

(3) Duties and Staffing of the Sewage Collection Section

The Sewage Collection Section should be responsible for all sewer maintenance works such as (i) daily inspection of sewer main/sub-mains; (ii) investigations of unexpected water influx into sewers and taking measures to prevent it; (iii) fixing of broken pipes and superannuated pipes; (iv) investigations of illicit wastewater, such as Industrial wastewater containing heavy metals, discharged into sewers, and preparation of reports on preventive measures; (v) inspection on the conditions of sewer main/sub-mains and sewage effluent facilities; (vi) cleaning of sewers and manholes; (vii) installation of new sewer pipes and replacement of old/damaged sewer pipes with new ones (to be contracted out, when necessary); (viii) installation of service connections; (ix) daily recording of operation and maintenance activities.

It should be noted that RDAWSSA will continue billing and charges collection for the sewerage services along with the water supply services.

Depending on the actual condition of the sewerage network (which was not studied in details during the F/S), the staffing of this section can be re-considered. The Section could be located either at the STP site or somewhere else in Zabadani.

3.2 Capacity Development

3.2.1 Necessity of Capacity Development

It is recognized that institutions in the water supply and sewage sector in Syria should be reformed. Thus, the 10th Five-Year Plan requires that all water and sewerage services in Syria are provided through highly efficient Establishments, functioning as autonomous public

companies. Such reforms are impossible without an adequate capacity of the staff. It is assumed that construction of the F/S project will be managed by the PMU and that all the constructed facilities will be transferred to the Sewerage Company upon completion of the project as discussed in the previous paragraph. Whereas a part of the staff of the PMU and this Company could be transferred from relevant divisions of RDAWSSA, the rest will be newly employed.

Any capacity development plans must be based on a thoroughly conducted training needs assessment (TNA) which should identify the gaps between the required and the existing skills. Since neither the PMU nor the Sewerage Company exists in practice yet, conducting a full-scope TNA in regard of the future staff is premature.

Notwithstanding, some preliminary ideas about the necessary capacity development can already be proposed. Thus, one can assume that capacity of the staff of the Sewerage Company to be established in Rural Damascus will not differ significantly from the capacity of the staff of a similar company already functioning in Damascus City (DSDC). Therefore, DSDC can be taken as a benchmark for assessment of the existing skills, i.e. it can be assumed that the same issues will be valid to a large extent in regard of the staff of the new Company in Rural Damascus. The following conclusion about the exiting capacity of DSDC was made in Chapter 4 of the M/P Report: “In general, due to lack of knowledge and skills in the O&M staff, their activities for the existing systems are busily occupied only in dealing with complaints from customers, being in the absence of the systematic and preventive maintenance, although they are well aware of the importance of O&M activities. They are also conscious of the necessity to challenge new treatment technologies that are more suitable in reusing the treated sewage for agricultural and other purposes.” Refer to M/P, Chapter 4 for more details behind this conclusion.

Therefore, capacity of the staff of the PMU and the Sewerage Company under RDAWSSA will apparently have to be strengthened both in technical (facility planning, development and rehabilitation of the sewerage system, daily O&M, etc.) and management aspects. Accordingly, an outline of the future capacity building program is proposed below.

3.2.2 Proposed Capacity Building Program

(1) Targets

The Capacity Building Program should contain the items which will be able to raise the capability of the staff of the future PMU and the relevant operations center of the Sewerage Company under RDAWSSA up to the level of satisfactory planning, O&M and management of the sewerage system in the F/S area.

(2) Timing

The Capacity Building Program for the PMU staff should be started at an early stage of the project implementation (2008) and for the Sewerage Company staff – before the end of construction (2012).

(3) Methodologies

The following methodologies are proposed for the Capacity Building Program:

1) TNA as the first required step;
2) A series of lectures, workshops as classroom trainings, as well as on the job training (OJT) by/with respective experts; and
3) Monitoring & Evaluation of the Capacity Building Program.

(4) Contents of the Capacity Building Program

A detailed Capacity Building Program and its implementation schedule will be developed during the TNA to be conducted during implementation of the F/S project in line with the time schedule of setting up the PMU and the Sewerage Company. Preliminarily proposed contents of the Capacity Building Program are summarized in the following table:

Table 3.2.1 Proposed Contents of the Capacity Building Program

Area	Contents
General Management Skills	- Training in project management, including foreign-funded projects - Training in Human Resource development - Training in financial management, accounting, budgeting - Training in relevant IT applications
Sewerage System Management	- Development of sewerage system management manuals and handbooks - Training on the sewerage system management, including tariff collection
Sewerage System Operation	- Development of O&M manuals - Training on operation and maintenance of the sewerage system
Database and GIS	- Development of database of sewerage system in GIS - Training on using the database
Environmental Management	- Development on environmental management plan - Training on environmental management including environmental monitoring

Source）JICA Study Team

(5) Cost Estimate

Whereas the capacity development should be considered as a continuous process, which requires a lot of recourses and efforts, it is proposed for the F/S project to include a respective Institutional Development component for implementation of the Capacity Building Program in the amount of at least 3% of the project direct cost.

(6) Preliminary Conditions

It is assumed that the PMU will be established to implement the project and that the Sewerage Company will take over responsibility for O&M of the sewerage systems upon completion of construction. Without meeting these pre-conditions, perspectives of developing an effective Capacity Building Program and its implementation are gloomy.

(7) Monitoring & Evaluation

During the course of the Capacity Building Program, its progress and results should be monitored by the PMU and achievements such as for instance the number of staff trained, skills transferred, etc. should be reported to the main stakeholders including the funding agencies, RDAWSSA, the Sewerage Company and so on. Finally, the overall evaluation of the Capacity Building Program should be made.

3.3 Operation and Maintenance Guideline

The significance of the existence of sewage works is fully demonstrated only when they are properly operated and maintained, and operation and maintenance are an ongoing task.
It may be said that O&M of sewerage consists of organic utilization of sewerage facilities, such as pipelines, pumping stations, and treatment plants, to collect wastewater without delay and to treat it adequately to maintain satisfactory final effluent quality. In other words, the objectives of sewerage cannot be achieved and the value of existence of sewerage may become dubious without adequate O&M.

On the other hand, from now on, the sewer service in Syria is going to just improve completely except for main big cities.
In order to carry out proper O&M, development of the indicator and standards about the O&M of sewerage facilities is indispensable.

In this chapter, the point on the O&M of sewerage facilities is described, putting a viewpoint mainly on a technical aspect. (The following description referred to “Tentative Guidelines for Optimization of Operation and Maintenance of Sewage Works in Developing Countries” [Infrastructure Development Institute-Japan])

3.3.1 Sewerage ledgers and records

(1) **Development of ledger**

1) To develop a ledger, research should be made on existing facilities.
2) It is desirable that ledgers consist of records and drawings.

In order to ensure adequate operation and maintenance of sewage works, it is essential to grasp the location, scale, and shape of facilities. The inventory or sewerage ledger provides fundamental information necessary for this purpose. A ledger should be developed for conduits, treatment plant, pumping station, and other facilities related to sewerage.
Development of sewerage ledgers enables clear definition of the sewerage area and users, which is important to achieve thorough collection of sewage service charges.

Reference materials to be filed and confirmed when developing the ledger are as follows:

a) Sewer system
- ✧ Pipe network map
- ✧ As-built plans(plan and longitudinal sectional views of the system)
- ✧ Flow calculation

b) Pumping and treatment facilities
- ✧ Drawings(Overall view, partial view, equipment assembly drawing, electric equipment drawing, connection diagram, elementary wiring diagram, material list, accessories, spare parts list, etc.)
- ✧ Various calculations (hydraulic and capacity calculations)
- ✧ Operation manual(including the equipment part type, type number and supplier list)

(2) **Storage and updating of ledgers**

1) Storage of the ledger should be strict and spares should be provided.

2) In case of alterations to the facility, the ledgers should be corrected immediately and without fail.

(3) **Preparation and control of records**

It is recommended to prepare and control the following records so that they can be referenced any time.

1) Maintenance and inspection records

2) Operation records

3) Water quality control records

4) Accident and complaints records

The records retain the operation state and maintenance/inspection history of facilities, and provide the important information necessary to enhance the subsequent operation and maintenance level, that is, adjust operation or develop the facility improvement plan. In certain cases, findings from operation and maintenance must be fed back to planning and design to achieve fundamental solutions of a problem that has occurred once. For such evaluation, the records are indispensable.

It is essential for recording that the implementation manual specifying record items and frequency, recording and storage method, feedback method, etc. be prepared to ensure planned and reliable implementation.

3.3.2 Operation and Maintenance of Sewer Systems

Sewers are the backbone of sewerage facilities. Being mostly underground structures, their abnormalities are more difficult to predict and detect than those at treatment plants or pumping stations.

On the other hand, any abnormality in conduits causes accidents directly affecting city activities and civil life, such as inundation of sanitary wastewater, road collapse, etc.

Objectives of operation and maintenance of sewers are as follows:

- ✧ Securing of flow capacity
- ✧ Prevention of accident caused by damage to facilities
- ✧ Prevention of infiltration/inflow (I/I)
- ✧ Extension of practical service life
- ✧ Prevention of damage to the facilities due to other work

Positive promotion of operation and maintenance of sewers contributes to reduction of the damage caused by accidents, prevention of increases in treatment costs caused by I/I, and asset utilization effects through extension of the practical service life of sewers.

From the long-term viewpoint, this is advantageous economically.

Efforts to prevent cross connections and I/I of unknown origin will also contribute to reduction of pollutant load on the public water bodies or adequate operation of the treatment plant and pumping station.

(1) **Operation and maintenance flow of sewer systems**

Operation and maintenance of sewers involves adequate implementation of maintenance inspections, cleaning, dredging, renewal, and repair along a flow series.

Operation and maintenance of conduits is implemented according to a flow of work shown in **Figure 3.3.1**.

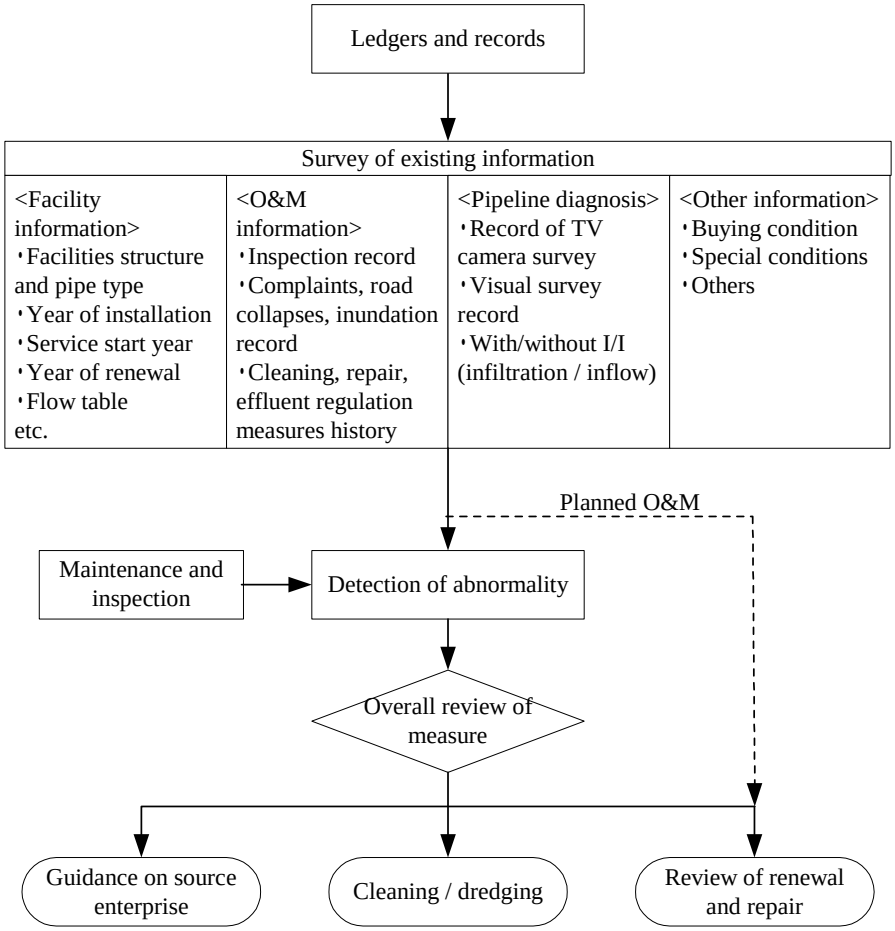


Figure 3.3.1 Operation and Maintenance Flow of Sewer System

(2) **Maintenance and Inspection**

1)Inspections of conduits should be made periodically.

2)Inspections should be made with an eye out for cross and illegal connections as well as on physical matters, such as sludge accumulation, conduits damage, etc.

3)Inspection results should be recorded.

4)Insufficient conduit capacity should be grasped with attention paid to wastewater amount survey results and the sewerage plan.

The example of a Maintenance and Inspection for conduit, and an investigation cycle is shown in **Table 3.3.1, 2**.

Table 3.3.1 Maintenance and Inspection Cycle for Conduit (Example)

Items / Elapsed Years after Start of Operation		Manhole, Pipe	Inverted siphon	Manholl type pumping Station	House inlet, Storm-water inlet	Gate
Maintenance and Inspection	0～30years	Every 3 years	Yearly	Monthly	Every 3 years	Every 6 months
	More than 30 years	Yearly				

Table 3.3.2 Survey Cycle for Conduit (Example)

Items	Place	Elapsed Years after Start of Operation	Cycle	Remarks
Visual survey (manhole inspection)	Manhole and connected pipes	0～30 years	Every 5 years	
		More than 30 years	Every 3 years	
TV camera survey	Less than Dia.800mm	0～30 years	Every 10 years	Including a Service Lateral
		More than 30 years	Every 7 years	Ditto

(3) **Cleaning and desludging**

1) Sediment should be removed as indicated by inspection and surveys.

2) In particular, sediment in trunk sewers should be removed before the rainy season.

The example of a cleaning cycle for conduit is shown in **Table 3.3.3**.

Table 3.3.3 Cleaning Cycle for Conduit (Example)

Items	Elapsed Years after Start of Operation	
	0～30 years	More than 30 years
Pipe	Every 5 years	Every 5 years
Manhole	Every 5 years	Every 3 years
Inverted siphon	Yearly	Yearly
Manhole type pumping Station	Every 3 months	Every 3 months
House inlet, Storm- water inlet	Every 5 years	Every 5 years
Service Lateral	Every 15 years	Every 5 years
Gate	Yearly	Yearly

(4) **Renewal and repair of sewer systems**

1) Implementation plans for renewal and repair should be established on the basis of inspection and survey results.

2) The plan should be established while taking into account active preventive measures from the viewpoint of life cycle.

3) Renewal and repair should be implemented according to the plan.

Deterioration of sewers proceeds over the surface as a whole, and renewal and repair takes considerable time. Therefore, it is necessary to implement renewal and repair according to the plan on the basis of the results of inspections and surveys. This practice will prevent the accident beforehand, thereby avoiding unnecessary social effects.

Particularly in cities of Syria, most sewers, though developed, have already exceeded service life. In such cities, adequate renewal and repair may cope with urgent problems and help extending the service life of facilities, reducing O&M expenses.

Flow of Rehabilitation Work is shown in **Figure 3.3.2**.

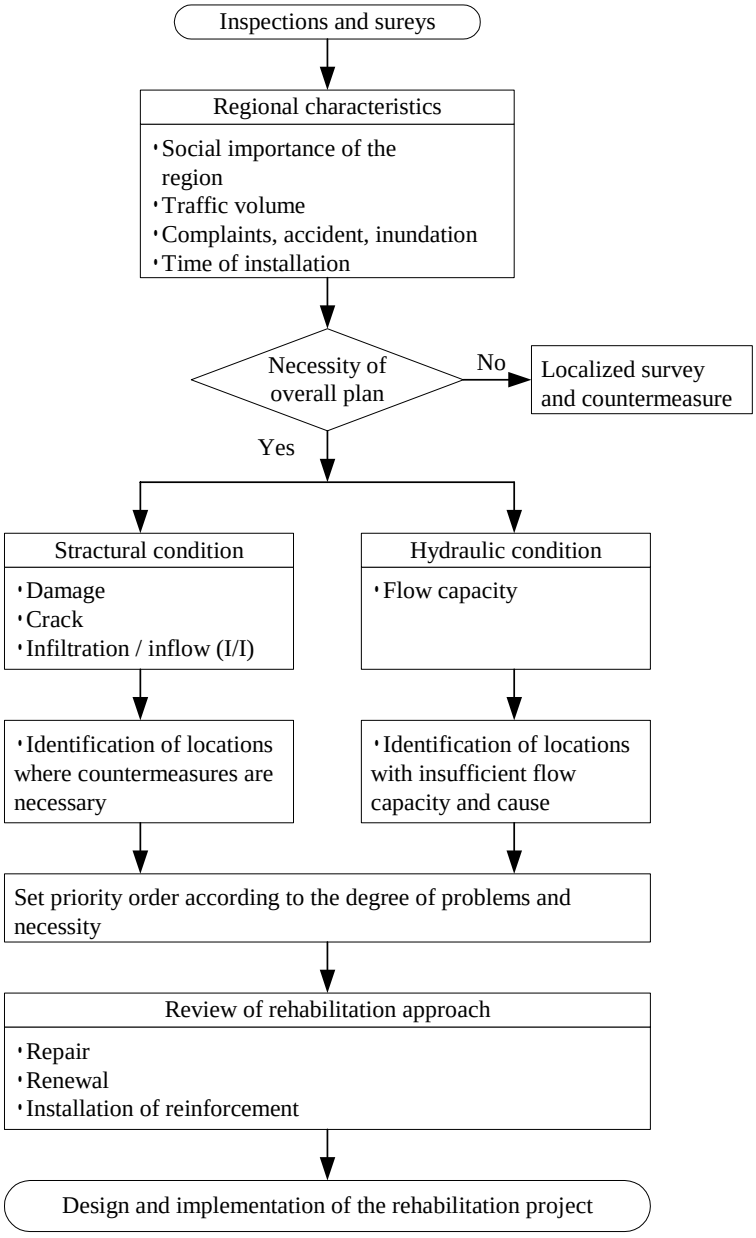


Figure 3.3.2 Flow of Rehabilitation Work

Table 3.3.4 shows the sewer structural diagnostic items and essential points.

Table 3.3.4 Principal Sewer Diagnostic Items and Essential Points

Diagnostic points		Diagnostic points
Degree of deterioration	Breakage, crack	Deformation of pipe, displacement of section, crack
	Corrosion	Aggregate and rebar exposure, pipe wall condition
	Joint displacement (faulty joint)	Clearance and displacement condition of joints
Flow capacity	Slackness, meandering	Degree of slackness and meandering (pipe size ratio), flow condition
	Projection of service laterals	Degree of projection (pipe size ratio), flow impedance
	Penetration of roots	Degree of penetration (pipe size ratio), flow impedance
	Adhesion of mortar and oil/grease	Degree of adhesion (pipe size ratio), flow impedance
Infiltration/inflow (I/I)		Spouting and leaching

3.3.3 Operation and Maintenance of the Pumping Station

The basic O&M objective of the pumping station is “not to stop functions.” O&M should be made on the basis of thorough understanding of characteristics of pump types.

(1) **Flow of pumping station O&M**
pumping station O&M should consists of adequate implementation of operation control, maintenance and inspection, renewal and repair, along a sequential flow.

Pumping station O&M should proceed along the flow shown in **Figure 3.3.3**.

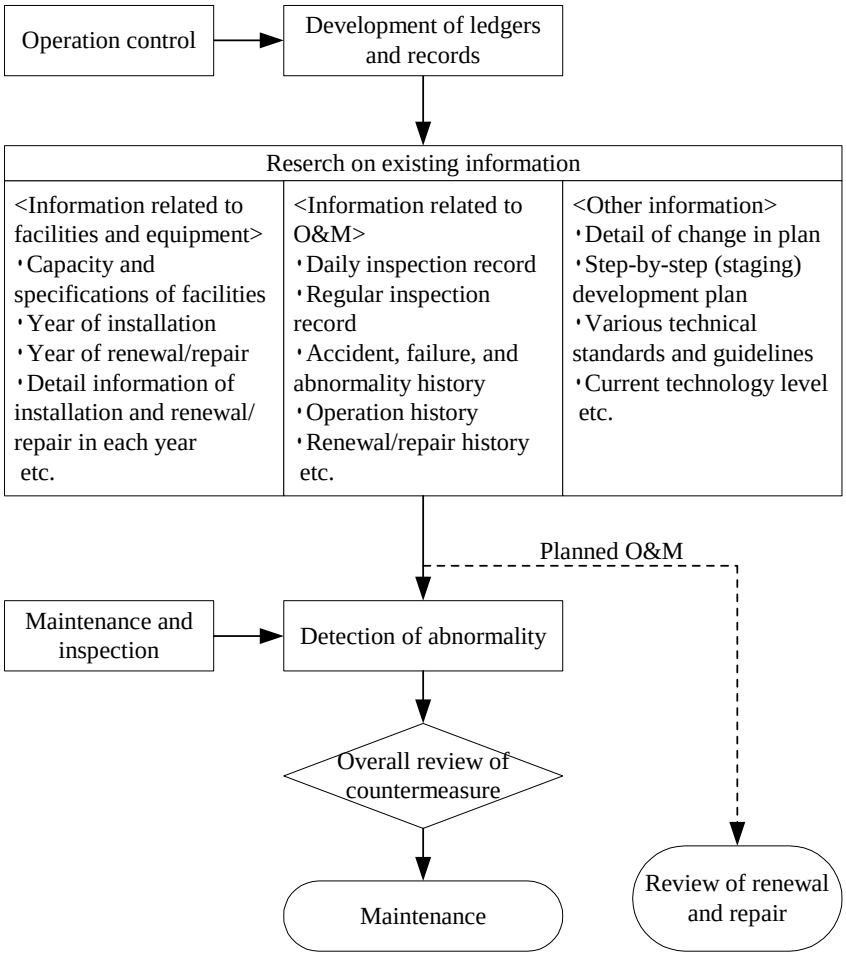


Figure 3.3.3 Flow of Pumping Station O&M Work

(1) **General matters**

1) Rearrangement and filing of operation manuals and specifications
2) Development of equipment operation manuals
3) Development of counteraction system during normal, abnormal, and emergency cases
4) Recording of the operating conditions in the daily log
5) Supply of grease as required to operating parts
6) Preventive measures against corrosion
7) Understanding of power and fuel consumption
8) Structures to prevent free entry of public

Typical check items and frequency about main equipment are shown in **Table 3.3.5** to **3.3.7**.

Table 3.3.5 Typical grit chamber equipment checks and their frequency

Equipment	Frequency	Check items
Screen	Daily	Use stop equipment to check the rake running condition, chain condition, oil level of motor and reducer, temperature; check for abnormal sounds, vibrations.
	Every month	Adjustment of chain tension
		Grease supply and oil application to chain
		Check limit switch operation
	Every 6 month	Looseness of set bolts
		Wire rope elongation and limit switch activation
	Yearly	Check wear condition of chain, shear pin, and sprocket wheel.
		Lubricating oil change
Grit collector	Daily	Use stop equipment and check the drive and chain bucket for damage
		Adjust drive chain tension, and check oil level of motor and reducer, temperature, abnormal sound, vibration, etc.
		Check shoe wear and damage
	Every month	(V-bucket conveyor type) Same as for screen
		(Sand pump type) Measure current value
	Every 6 month	(V-bucket conveyor type) Same as for screen
		(V-bucket conveyor type) Measure wear of shoes and rails
	Yearly	(V-bucket conveyor type)Same as for screen
		(Sand pump type)Check main body for damage
		(Sand pump type) Check lubricating oil for deterioration

Table 3.3.6 Typical gate checks and their frequency

Equipment	Frequency	Check items
Gate	Daily	Check the opening.
		Check oil level (hydraulic type)
	Every month	Operation check (including measurement of opening/closing time and check current value)
	Every 6 month	Operation check of limit and torque switches
		Grease application to the thread
		Lubricating oil change
	Yearly	Measurement of oil deterioration condition
		Check seat and spindle for damage
		Check gate, main body, each valve seat, and lower stopper for damage and corrosion.

T able 3.3.7 Typical Check Items and Frequency of the Pump

Check items	Check content	Frequency
Current and pressure check	Ensure current and pressure are normal	Daily
Abnormal sound and vibration check	Check for abnormality	Daily
Leakage check	Check for leakage	Monthly
Inspection and cleaning of float switch	Operation check	Monthly
Appearance check by lifting the pump	Check for abnormality	Every 3 months
Check of lubrication oil condition	Foulness and amount	Every 3 months
Lubrication oil change	—	Yearly

T able 3.3.7 Typical Check Items and Frequency of the Pump

Check items	Check content	Frequency
Overhaul	Wear of rotating slide section	Irregular (approximately every 2 years)

3.3.4 Operation and Maintenance of the Treatment Plant

The objective of O&M of the treatment plant is to meet effluent standards or targeted water quality through full demonstration of wastewater treatment functions, thereby contributing to securing of public hygiene and conservation of the quality of public water bodies.

(1) **Flow of O&M at treatment plants**

O&M of treatment plants should involve adequate implementation of operation control, maintenance and inspection, renewal, and repair according to a work flow

O&M of the treatment plants should proceed according to the flow shown in **Figure 3.3.4**.

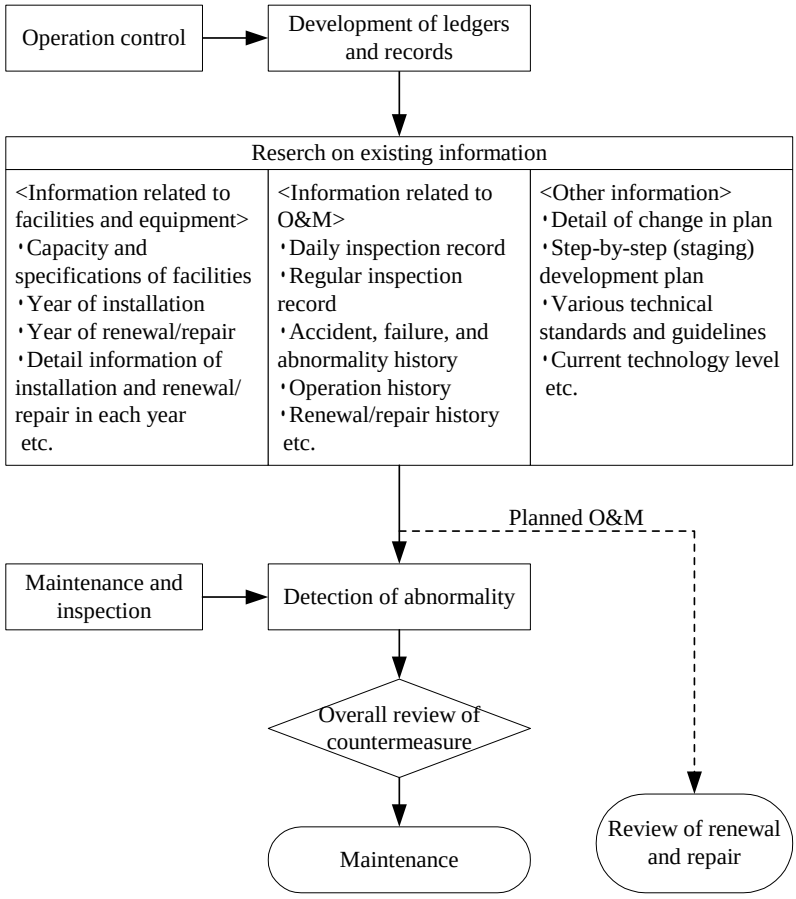


Figure 3.3.4 Flow of Treatment Plant O&M Work

(1) **General matters**

1) Securing appropriate number of administrative personnel
2) Development of equipment operation manuals
3) Establishment of a system to respond to normal, abnormal, and emergency cases
4) Arrangement of design and completion documents
5) Recording of operation conditions and inspection results in daily logs
6) Grasping of power and fuel consumption
7) Observance of related laws and regulations
8) Structures preventing arbitrary admittance of unauthorized personnel

Appropriate number of personnel

As the appropriate number of personnel to be assigned to treatment plants varies depending on the treatment method and scale, degree of automation, etc., it is essential to consider staffing according to the situation.

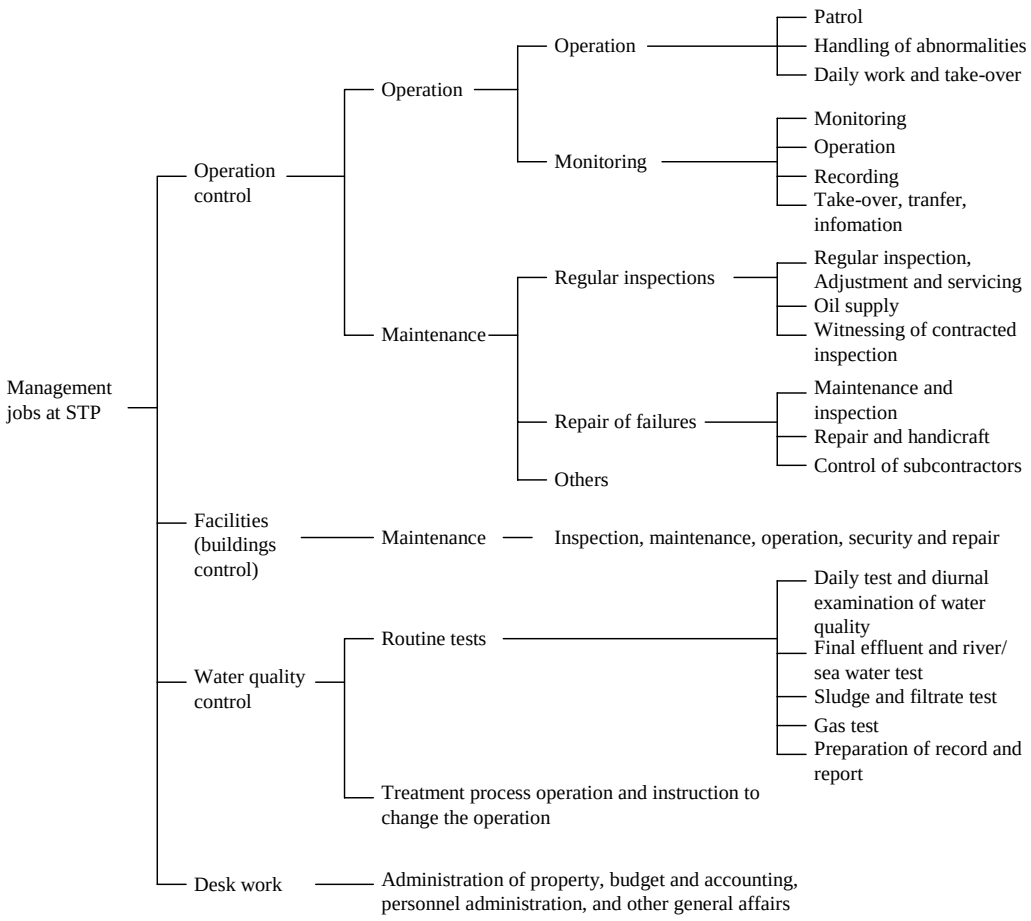


Figure 3.3.5 Standard Job Assignments for Treatment Plant O&M

Operation records

In order to ensure efficient control of plant operation, it is indispensable to record operating conditions in daily and monthly logs and to evaluate the conditions. The types and contents of operation records are shown in **Table 3.3.8**.

Table 3.3.8 Types and contents of operation records

Type	Contents
Daily operation log	Record of the operating conditions and results of the day on the basis of indicated data of continuous equipment in the monitoring room and job site. It basically contains the following data: a. Treatment results b. Items directly related to operation costs, including electric power, chemicals, etc. c. Compulsory matters, such as legal regulations, etc. d. Operating conditions of principal facilities and equipment
Daily operation report	Summarizes principal items on the basis of daily operation log to understand and report on operating conditions of the day
Monthly operation report and year book	Used as reference data for operation methods and the facility/equipment improvement plan. The daily operation log is summarized in the monthly report, and the monthly operation report is summarized in the year book.

The important thing in the wastewater treatment plant is to check the site every day to get a feel for any changes (abnormalities). Personnel expenses are smaller than equipment costs in Syria, so workers may be assigned to dedicated administrative staff. Therefore, inspection can be made mainly through utilization of the five senses. If well-experienced, the staff can achieve considerable effects through such simple checks as those outlined below.

Table 3.3.9 Sensory Inspection

Visual Inspection	Check condition of treatment ponds and activated sludge. Check for equipment failure
Auditory Inspection	Check for any abnormality in equipment
Smell Inspection	Foul odor, scorched odor
Touch Inspection	Feel operation temperature of equipment, check for vibrations

3.3.5 Water quality control

(1) **Control of effluent water quality**

1) In the treatment facilities, efforts should be made to maintain treatment functions properly, to observe the regulations related to water quality and to conserve the receiving water body.

2) From environmental and sanitary viewpoint, particular care should be taken when treated wastewater or sludge is to be reused for agricultural water or fertilizer.

(2) **Water quality monitoring**
1) Water quality monitoring should be undertaken as required to determine the adequacy of the treatment plant and to observe the regulations.
2) Monitoring records should be maintained and stored.

Typical examination items and frequency of STP are shown in **Table 3.3.10, 11**.

Table 3.3.10 Typical Examination Items and Frequency of Wastewater Treatment

Objects \ Frequency	Daily Check	Periodical Check (More than every month)
Wastewater influent	appearance, odor, water temperature, transparency, pH	BOD, SS
Aeration tank (Activated sludge method)	appearance, odor, SV(sludge volume), water temperature, DO(dissolved oxygen), MLSS(mixed liquor suspended solids)	microorganisms dimension, MLSS
Effluent of Final sedimentation tank	appearance, transparency, pH Nitrate nitrogen*, ammonia nitrogen* (*: easy test)	BOD, SS nitrate nitrogen, ammonia nitrogen
Final effluent (Be care about legal regulation)	appearance, transparency, pH, residual chlorine	BOD, SS, COD (nitrate nitrogen, ammonia nitrogen)

Table 3.3.11 Typical Examination Items and Frequency of Sludge Treatment

Objects	Frequency	Category		Remarks
		Daily	As appropriate	
Sludge thickening facility	thickened sludge	appearance	water temperature, pH, TS(total solids)	
	supernatant	pH, SS	COD, TN(total nitrogen), TP(total phosphorus)	
Sludge dewatering facility	dewatered sludge	appearance	moisture content, coagulation test※	※in case of moisture content rise
	supernatant	SS	COD, TN(total nitrogen), TP(total phosphorus)	

3.4 Public Relations on Sewerage system

3.4.1 Necessity of Public Relations

Sewerage service has the peculiarity that the contents of the service are not visible, compared with a "water supply service" and "garbage collection service" as it is symbolized by the pipeline laid under the road.
The Sewerage service with such peculiarity must perform project management more than other public service, being based on a confidential relation with residents.
Public relation is regarded as necessary activity to gain the support to a sewerage project, asking residents for an understanding widely about "Role and effect of a sewerage", "Sewerage

development plan", "Structure of sewerage finance", etc., in order to make visible the sewerage which is not easily visible.

Generally, as for the public relation of administration, emphasis tends to be put on the public announcement as a communicative function which asks residents for an understanding and cooperation by offering information. However, it is important to enrich public hearing as an information gathering function which hears the opinion of the residents to administration from now on.

3.4.2 Methods of Public Relations

Typical Public Relations methods are shown below.

(1) Public announcement
1） General announcement
a. Publicity（TV, radio, newspaper）
b. Printed material（brochure, poster, booklet）
c. Image（movie, video, CD-ROM）
d. Information offered municipality（public relations magazine）
e. Various occasion（visiting of facility, event, campaign）
f. Interactive media（homepage）
g. Others（Signboard of construction etc.）
2)Individual announcement
a. Briefing（about construction, about house connection, about payment by beneficiary）
b. Individual information service
3)Others
Resident correspondence in daily work

(2) Public hearing
1） General hearing
a. Gathering（town meeting）
b. Research（questionnaire, monitor survey）
c. Consultation（complaint report, resident proposal）
d. Interactive media（homepage）
e. Others (conversazione etc.）
2)Individual hearing
a. Briefing（about construction, about house connection, about payment by beneficiary）
b. Individual information service
3)Others
Resident correspondence in daily work

3.4.3 Procedure of Public Relations

It is important to care about the following point in implementation of public relations.

(1) Effective and efficient public relations

It should be carried out utilizing bilateral work with other public service such as a water supply service, cooperation with a civic organization or a volunteer, cooperation request to a school, etc.

(2) Clarification of purpose and object

It should be carried out after clarifying what is transmitted to whom.

(3) Planned public relations

It should be carried out from long-term viewpoints, such as a check of implementation timing or frequency, and selection of effective methods.

3.4.4 Examples of Public Relations Plan

The example of the public relations plan in each stage of sewerage project is shown in **Table 3.4.1**.

Table 3.4.1 Examples of Public Relations Plan

Stage	Purpose	Objects	Examples of Activity	
			Method	Contents
Concept	To enhance opportunities for sewer development	・Citizens	・Publicity ・Inspection of advanced area ・Lecture ・Public relations magazine ・Homepage	・Understanding of the necessity for a sewerage, and public announcement which enhance opportunities for embodiment of a plan ・A explanation about increase of financial responsibility ・Public hearing about request of a sewerage
Plan	Complete understanding of a sewerage	・Citizens including children	・Publicity ・Inspection of advanced area ・Lecture ・Public relations magazine ・Homepage ・School lessons	And more above, ・Public announcement about effect of sewerage development
	Publicity of sewerage plan	・Citizens ・Related residents （Especially, to the residents who live near the STP site）	・Publicity ・Inspection of advanced area ・Briefing ・Lecture ・Public relations magazine ・Homepage ・Brochure	And more above, ・A explanation about economical efficiency of sewerage , and the reason for selection of STP site ・Public hearing about request for the sewerage plan
	Publicity of payment by beneficiary	・Citizens	・Publicity ・Briefing ・Lecture ・Canvass ・Public relations magazine	And more above, ・Public announcement about necessity for a payment by beneficiary based on the increase of environmental improvement, convenience and amenity accompanying development of sewerage, the increase

Table 3.4.1 Examples of Public Relations Plan

Stage	Purpose	Objects	Examples of Activity	
			Method	Contents
			・Homepage ・Brochure	in asset value etc. ・Public hearing about the situation of a prevention factor, and planning of a measure
Construction	Cooperation request to construction	・Residents near the construction site	・Public relations magazine ・briefing ・Homepage ・Brochure ・Signboard of construction	・Public announcement for aiming at smooth implementation of construction, and an understanding of the contents of construction (construction outline, processing organization for a complaint etc.) ・Publicity of schedule for start of operation, and an understanding to a sewerage ・Public hearing about the request for construction
	Publicity of schedule for start of operation	・Residents and business establishment in the service area	・Publicity ・Briefing ・Public relations magazine ・Homepage ・Brochure	・Publicity of setting a house connection ・Recommendation on early house connection ・Public hearing about the situation of a prevention factor, and planning of a measure
Operation&Maintenance	Promotion of house connection	・Residents and business establishment in the service area	・Briefing ・Canvass ・Homepage ・Brochure	・Publicity of setting a house connection ・Recommendation on early house connection ・Public hearing about the situation of a prevention factor, and planning of a measure
	Publicity of right usage	・Residents including children and business establishment in the service area	・Publicity ・Visiting of STP (including for children) ・Public relations magazine ・Homepage ・Brochure	・Public announcement about right usage of sewerage (setting of pretreatment facility for discharge to sewerage system, prohibition of pouring oil from kitchen etc.)
	Rehabilitation	・Residents and business establishment in the service area	・Publicity ・Visiting of Facility ・Public relations magazine ・Homepage ・Brochure	・Public announcement about necessity for the renewal / repair to decrepit facilities

CHAPTER 4 COST ESTIMATION AND IMPLEMENTATION SCHEDULE

4.1 Condition of the Project Cost Estimation

The Project financial cost comprises the following cost items.

- Construction Cost
- Engineering Services Cost
- Government's Administration Cost
- Organizational Development Cost
- Physical Contingency
- Price Contingency

Refer to Chapter 10.1 of Master plan report for the details of each component.
In addition, Estimation approach for construction cost of STP in F/S is as follows.

Civil / Building works

The construction costs for Civil/Building works are estimated by unit cost basis. The unit construction costs of respective work items are presented in Appendix. The unit cost is set by using data which were collected, examined and analyzed during the site investigation.

Mechanical / Electrical works

The cost for major mechanical and electrical equipment such as pumps, aerator, sludge collector, dewatering machine, control panels and power receiving/transforming equipment are decided by quotation basis which is collected from local agencies of foreign contractor in Damascus.

Foreign and Local Currency Portions

The project cost estimates are divided into the foreign currency portion (FC) and local currency portion (LC). The unit construction costs are divided into foreign and local currency portions according to certain ratios that take account of market conditions in Syria.
The division of foreign and local portions for each project component is shown in Chapter 2.2.2 (procurement plan).

4.2 Project Cost for Stage-I (2015)

A summary of the project cost for Zabadani project (Stage-I :Target year 2015) is shown in **Table 4.2.1**. The details of cost estimate are shown in Appendix 6.1.

Project components

STP: Q=18,250 m^3/day (Oxidation Ditch Method)

Pipes: Dia. 800mm, L=100 m

Table 4.2. 1 Project Cost for Zabadani

Items	FC portion	LC portion	Total (10^3SP)
Construction Cost			
1) STP *1	234,208	270,735	504,944
2) Pipe		1,250	1,250
Total of Construction Cost	**234,208**	**271,985**	**506,194**
Land Acquisition Cost	-	-	
Engineering Cost	45,557	5,062	50,619
Government's Administration Cost	-	25,310	25,310
Organizational Development Cost	-	15,186	15,186
Physical Contingency	23,421	27,199	50,619
Sub Total	**68,978**	**72,756**	**141,734**
Price Contingency	65,971	57,080	123,050
Total (Excluding Price Contingency)	**303,186**	**344,741**	**647,928**
Total	**369,157**	**401,821**	**770,978**

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

4.3 Operation and Maintenance Costs

O&M (Operation and Maintenance) cost comprises the following items.

- Running Cost of STP (Refer to Appendix 4.2)
  - Personal Expense
  - Power (Electric cost)
  - Chemical Cost
  - Repair and Maintenance etc.
- Running Cost of Pipes

  The annual running cost of Pipes assumed the cleaning, dredging and repair of pipes. 0.5 percent of construction cost for pipes is applied.
- 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.
- Other Costs

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

In addition, Estimation approach for running cost of STP in F/S is as follows.

Running cost of STP

The running costs of STP are estimated by unit cost basis. The unit running costs of respective work items are presented in the Supporting Report. The unit cost is corrected by using data which were collected, examined and analyzed during the site investigation.

Annual O&M cost for the Zabadani project at 2015 (18,250 m^3/day) is shown in **Table 4.3.1**.

Refer to Appendix 4.2 for the details of Running cost of STP.

Table 4.3.1 Annual O&M Cost for Zabadani Project (at 2015)

O&M Items	Total (10^3SP)
Running Cost of STP	**15,500**
Personal Expense	1,943
Power	10,227
Data Base	1,886
Other Costs	1,444
Running Cost of Pipes	6
Data Base	500
Other Cost	1,601
Total (Excluding Price Contingency)	**17,607**

4.4 Disbursement Schedule

Annual disbursement schedule of the project is shown in **Table 4.4.1**.

Table 4.4.1 Annual Disbursement Schedule

Disbursement Schedule

Unit : 10^3 SP

	Total Cost (10^3SP)			2008		2009		2010		2011		2012		2013		2014		2015	
	FC	LC	Total	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC
Construction Cost	234,208	271,985	506,194					6,491	104,148	96,929	160,368	130,788	7,469						
Land Acquisition Cost			-																
Engineering Service Cost	45,557	5,062	50,619			22,722	2,525	6,223	691	11,417	1,269	5,194	577						
Government's Administration Cost	-	25,310	25,310	-		-		-	5,532	-	12,865	-	6,913	-		-		-	
Organizational Development Cost	-	15,186	15,186	-		-		-	3,319	-	7,719	-	4,148	-		-		-	
Physical Contingency	23,421	27,199	50,619					649	10,415	9,693	16,037	13,079	747						
Price Contingency	65,971	57,080	123,050			818	91	1,478	13,725	22,493	37,779	41,182	5,485						
Total of Annual Disbursement	**369,157**	**401,821**	**770,978**			23,540	2,616	14,842	137,831	140,532	236,036	190,243	25,339						

Operation & Maintenance Cost

Unit : 10^3 SP

	Total Cost (10^3SP)	2008	2009	2010	2011	2012	2013	2014	2015
Running Cost of STP and PS	45,481						14,821	15,160	15,500
Running Cost of Pipes	19						6	6	6
Data Base	2,500						1,500	500	500
Othres	4,800						1,633	1,567	1,601
Price Contingency	24,731						6,612	8,042	10,076
Total of Annual Disbursement	**77,531**						24,572	25,276	27,683

4.5 Implementation Schedule

Implementation schedule of Stage-I (Target year : 2015) is summarized to below.

Pre-construction Stage

2008 : Preparation of project (Financial arrangement, Selection of consultant)

2009 : Pre-construction (Detailed design, Bidding)

Construction Stage

2010-2012 : Construction (STP)

2012 : Construction (Trunk sewer)

Operation & Maintenance Stage

2013~ : Commencement of Operation

Table 4.5.1 Implementation Schedule

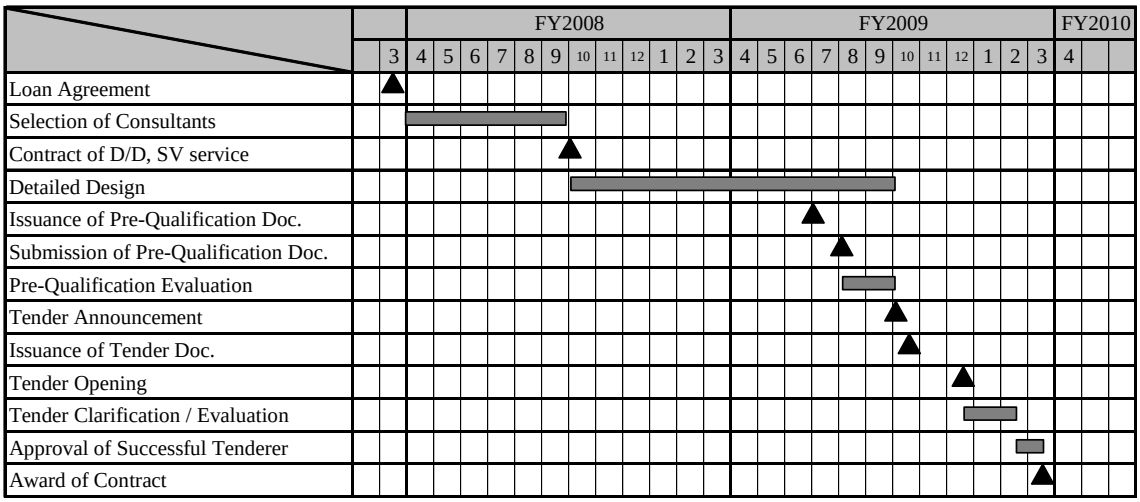
	2008	2009	2010	2011	2012	2013	2014	2015	
	1	2	3	4	5	6	7	8	
Pre-Construction Stage	←	→							
Preparation of Project	(Financial Arrangement, Selection of Consultant)								
Pre-Construction		(Detailed Design, P/Q and Tender)							
Construction Stage			←	→					
STP									
Pipes									
Operation & Maintenance Stage						→	→	→	

4.6 Schedule of Pre-Construction Stage

Before award of contracts for contractors, there are several procedures or stages are required such as detailed design, pre-qualification of contractors, bidding, and bid evaluation as pre-construction stage.

Schedule of the pre-construction stage is prepared as shown on **Table 4.6.1** to be able to commence the constructions from the year 2010. As shown on this schedule, it is recommended to complete budgetary arrangement by the end of fiscal year 2007.

Table 4.6.1 Schedule of Pre-Construction Stage



CHAPTER 5 ECONOMIC AND FINANCIAL EVALUATION

5.1 Economic Evaluation

5.1.1 Methodology of Economic Evaluation

The F/S sewerage system development project was designed to contribute to the public welfare. It brings various social and economic benefits to the society and financial profitability can hardly be considered as its major mission. Therefore, the Economic Internal Rate of Return (EIRR) approach was primarily used for the project justification.

Only the incremental economic costs and benefits that are relevant to the scope of the F/S project were taken into consideration.

For the EIRR calculation the F/S project life span was taken through to the end of the M/P design period, i.e. through to the year 2025.

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

All flows of economic costs and benefits (discussed below) were taken in nominal prices. Following the assumption adopted for the cost estimation, inflation of 7.2% p.a. was applied to the flows of economic costs and benefits until 2025. This rate was adopted based on the official data of Central Bank of Syria.

5.1.2 Economic Costs

The project's economic costs are comprised of (i) the capital costs of the F/S project as per the cost estimate, but excluding the assumed overall tax of 5%; and (ii) incremental (i.e. a difference between "with project" and "without project" scenarios) O&M costs throughout the project life. The O&M cots in the year 2015 were farther adjusted for inflation and extrapolated to the period from 2016 to 2025 in order to exclude irrelevant costs.

5.1.3 Economic Benefits

Efforts were made to estimate a number of economic benefits. The following economic benefits were taken into consideration: (i) tourism development, (ii) health benefits relating to reduction of the productive time lost, (iii) health benefits relating to reduction of medical expenditures; (iv) use of treated wastewater; and (v) use of sludge as fertilizer. Only these five quantified economic benefits were taken into account while arriving at the EIRR figure, whereas many potential economic benefits of improving the sewerage treatment and disposal were not readily quantifiable, especially in economic terms.

(1) Tourism Development

Syria in general and the F/S project area (Zabadani) in particular are important tourist destinations. The following estimates were made regarding the current population and the number of tourists visiting the F/S project area, based on the population forecast that was made in the "Planning Fundamentals":

Table 5.1.1 Estimated Existing Number of Tourists in F/S Project Area

Municipality	Local population estimate 2008 (thousand)	Tourists as % of local population in tourist season	Duration of tourist season (weeks)	Duration of stay by one tourist (weeks)	Existing number of tourists (thousand)
Zabadani	28.8	120%	16	1	553
Bloudan	3.2	300%			154
Bukein	1.9	250%			76
Madaya	9.7	20%			31
Total F/S Area					**814**

Source) Ministry of Tourism, also see "Planning Fundamentals".

The Ministry of Tourism expects that after implementation of the F/S project the existing number of tourists in the F/S area may increase by as much as 50%. However, taking into account that attracting new tourists is a comprehensive task, which requires coordinated actions in many areas, implementation of a new sewerage system as per se may not lead to this expected result, if not supported by other measures. Therefore, it was prudently assumed in the economic analysis that the existing number of tourists would increase by 5% due to the sewerage system implementation.

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

It also follows from the above table that the number of permanent population currently living in the F/S project area (estimated as approximately 44,000) is approximately 0.2% of the total population of Syria of 21,061,000 (2006).

(2) Health Economic Benefits - Productive Time Lost

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).

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 for its treatment and each case of diarrhea – one week, it was estimated that approximately 3,800 person-years were lost due to officially registered incidences of the waterborne and water-related diseases amongst the entire population of Syria, i.e. 8 person-years can be attributed to the F/S project area (0.2% of 3,800). In addition to this official statistics, significant number of unregistered cases of water-related diseases happens. Thus, according to the results of the conducted Social Survey, one family member suffers from water-related diseases 17 days a year on average. Taking into account that not all of these 17 days represent losses of the productive time and based on interviews amongst the local employees, it was arbitrary assumed that each person loses on average 3 working days a year due to the waterborne and water-related diseases, which are not registered officially. It results in additional 362 person-years lost (44,000 population × 3 / 365). Therefore, the total number of registered and non-registered person-years lost in the F/S project area can be estimated as 370 (8 plus 362). It was assumed that these losses would grow in line with the population growth.

The economic cost of the above-calculated 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.

Finally, assuming that the F/S sewerage project will allow reducing the incidence of the waterborne and water-related diseases by 40% (and accordingly 60% were assumed to be caused by the reasons other than lack of a sewerage system), the economic benefit from reduction of the production time lost was estimated as 40% of the losses. 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).

(3) Health Economic Benefits – Medical Expenditures

According to the World Health Organization statistics (www.who.int), the per capita total expenditure on health in Syria accounts for USD 108.8 (2004), i.e. approximately SP 5,500. This figure covers by definition both the public and private expenditures on health. Since there is no reliable statistics on this matter, based on discussions with the Ministry of Health representative, it was assumed that only 15% of the total health expenditures, which is approximately 820 SP/capita annually (SP 5,500 × 15%), can be attributed to treatment of the waterborne and water-related diseases. Accordingly, this figure was applied to the number of population of the F/S area to derive the total medical expenditures related to the waterborne and water-related diseases. It was assumed that the medical expenditures would grow in line with the population growth. Finally, similar to the above-discussed benefits associated with reducing

the cost of productive time lost, only 40% of these expenditures were taken as the expected economic benefits upon completion of the F/S project.

(4) Economic Benefits of Using Treated Wastewater

After implementation of the F/S project, the treated wastewater is planned to be used for irrigation. Indeed, 74% of the respondents of the Social Survey who irrigate their farm land (mostly downstream of Barada river) would like to use the treated wastewater. Since the water for irrigation is mostly used during the summer months, it was assumed that only 30% of the treated water would be used.

The water which is currently used for irrigation represents a scarce recourse in the F/S area and therefore the treated wastewater for irrigation should be valued at the opportunity cost of the saved scarce resource – drinking water. While different methods can be used for economic valuation of the saved drinking water, discussion of which is beyond the scope of this study, one of the common methods is to use the willingness of water consumers to pay. It is believed that the willingness of customers to pay for the drinking water is only marginally higher than the existing lowest-tier water tariff. Accordingly, 3 SP/m^3 was taken as the economic value for the treated wastewater, but it should be noted that this value might be significantly understated.

(5) Economic Benefits of Using Sludge as Fertilizer

The conducted Social Survey confirmed that 67% of respondents downstream Barada river would like to use treated sludge as fertilizer. The experience of Damascus Sewage Treatment Plant also confirms that the digested sludge produced by the plant can be sold as a fertilizer for agriculture. Currently the sludge is sold in Syria at 200 SP/m^3, which was assumed to be the market price for valuation of its economic benefits. It was estimated that 27.5 m^3/day would be produced upon the F/S project implementation. Taking into account that a high demand is confirmed by the experience of Damascus Sewage Treatment Plant and results of the Social Survey, it was assumed that all this sludge could be sold out as fertilizer.

(6) 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 of value of land and real estate, enhanced opportunity for business development (apart from the tourism sector discussed above), and so on, to be mentioned but a few. These benefits were ignored solely because they were not quantified.

5.1.4 Results of EIRR and NPV Calculation

The EIRR calculated for the F/S project based on the above assumptions is 12.9%. The respective Net Present Value (NPV) at the discount rate of 10% is SP 108.8 million. Details of the EIRR and the NPV calculation are provided in **Appendix 5.1**.

Therefore, notwithstanding the conservativeness of the assumptions that were made, the F/S project is feasible from the economic point of view.

5.2 Financial Evaluation

5.2.1 Purpose and General Assumptions of Financial Evaluation

The main purpose of any project's financial evaluation is to ensure financial viability of the proposed project. A financial plan is supposed to determine the amount of funds required to finance the project, as well as the possible sources for these funds.

A simple financial model was developed for financial evaluation of the F/S project under different scenarios. The main assumptions that were taken in the financial model and the possible scenarios are discussed below.

Only those incremental cash flows that are relevant to the scope of the F/S project were taken into consideration.

Cash outflows of the project (i.e. financial costs) are comprised of the capital costs and the O&M costs. Refer to the F/S project cost estimate for details of the project costs.

Regarding the O&M costs, it should be pointed out that they represent only project-related incremental O&M costs and therefore may not include certain costs relating to sewage collection, Sewerage Company administration and other costs that are considered irrelevant from the F/S project perspective. Due to deficiencies of the adopted financial accounting system, no reliable estimate of the total O&M costs for sewerage collection and treatment in the F/S area could be made and accordingly only the incremental O&M costs were used in all financial projections. However, the unit O&M costs that were estimated and used in the financial evaluation are about 2.6 SP/m^3 (in constant 2008 prices). This figure is comparable to the O&M costs estimated by the management of the already functioning in Syria 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.

Cash inflows of the project (i.e. financial revenues) are comprised of the sewerage charges, both fixed and volume-based. A difference between domestic and non-domestic sewerage tariffs was taken into account in the model by further increasing the tariffs by 10%.

The F/S project could be funded from different sources, such as for instance the Public Debt Fund, by a loan, by a grant of an international donor agency, and so on. The concrete sources of funding are not determined yet and supposed to be decided at a later stage of the project development cycle. Refer to Chapter 9 of this report for further considerations.

Due to uncertainty with the project funding, all financing-related items including possible interest payments are shown in the financial model separately, where applicable. As an example but not requirement it is assumed that the project will be partially (under the 50% Capital Cost Recovery Scenario) of entirely (under the Financial Feasibility Scenario) financed by a loan, and that this loan will be taken on the following terms: repayment period - by the year 2025, grace period - during the construction period, interest rate - 10% in nominal terms.

5.2.2 Affordability to Pay Assessment

Affordability of the water and sewerage charges based on the latest (November 2007) tariff table is assessed below. It should be noted that namely affordability of the combined water and sewerage tariff should be considered first, taking into account that the water supply sector itself is heavily subsidized and thus also requires for the water tariffs to be increased.

An average household in the F/S project area is forecast to consume approximately 20 m^3 of water per month (115 lcd × 30 days × 5.7 household members / 1000), which would cost them approximately SP 73 (applying the latest tariffs of 2.5 SP/m^3 and 7 SP/m^3 for water consumption of up to 15m^3 and more than 15m^3 respectively). Adding the monthly portions of fixed charges (network and water meters maintenance fees) in the amount of SP 41, the total theoretical monthly water charges in the F/S area should be approximately SP 114.

The assumed average sewerage charges are comprised of SP 10 as a monthly portion of fixed charges (SP 120 / 12), plus SP 4 as a volume-based charge (5% of SP 73 charged for water), i.e. SP 14 in total. It should be reminded that currently the sewerage charges in the F/S area are not paid and this is only a theoretical charge. Hence, the future combined average water and sewerage charges could be estimated as 128 SP/month.

According to the conducted Social Survey, the average household income in the F/S project area is SP 23,000 (which is apparently above the country average). Therefore, the theoretically estimated water and sewerage charges account for only 0.56% of this income. It means that the existing tariffs are affordable, considering the 4% - 5% threshold usually taken by international donor agencies for the water and sewerage charges. Moreover, there is a significant leeway for the future tariffs increase (approximately 8 times), without jeopardizing their affordability, but assuming that the social safety net is in place.

Furthermore, it is believed that the current recoverability of the O&M costs in Syria is higher for the water supply system than for the sewerage system. Therefore, the sewerage tariffs could be raised even more than 8 times subject that the water tariffs are raised less than 8 times. Using a figure of 1% of the household income as an affordability threshold for the sewerage charges only, the sewerage tariff could be raised up to the average of 230 SP/household/month, making sure that the combined water and sewerage charges do not exceed SP 1,150 (5% of the household income SP 23,000) as the worst case.

5.2.3 Willingness to Pay

Willingness to pay for sewerage services was analyzed based on the results of the above-mentioned Social Survey. The vast majority of respondents (92%) believe that the sewerage system in the F/S area needs to be improved. Of the respondents, 21% agree to pay for such improvement less than 50 SP/month, 27% - from SP 50 to SP 100, 29% - more than SP 100, and 23% of respondents do not want to pay for improving of the sewerage service at all. Since the estimated future average sewerage charges under the current tariff table account for only 14 SP/month, there is also apparent flexibility in raising the existing sewerage tariffs even from the willingness to pay point of view, subject that the service is really improved and the public awareness raised.

5.2.4 Results of Financial Evaluation under Different Scenarios

The financial model was run under four different scenarios of setting the tariffs that are discussed below.

(1) Baseline Scenario

The Baseline Scenario assumes that the existing tariff table will be applied to the F/S project area throughout the project life and that this tariff table will be annually adjusted to compensate for inflation only. Taking into account an increasing-type of the adopted tariff table, the existing weighted average volume-based domestic sewerage tariff was assumed under the Baseline Scenario as approximately 0.2 SP/m^3 (5% of the weighted average water tariff of 3.6 SP/m^3). The fixed sewerage charges were assumed as 120 SP/year/household.

Under this scenario, the F/S project shows strongly negative cash flows throughout the project life. The forecast cash inflows are far below the incremental O&M costs (the O&M cost recovery rate is approximately 15% even assuming the 100% collection of bills), not to mention recovery of any capital or interest costs. Therefore, no attempts were made to assess financial viability of the investment by calculating its Financial Internal Rate of Return (FIRR), which is not applicable in such cases by definition.

The NPV under this scenario is minus SP 655.7 thousand (negative).

Details of financial evaluation under the Baseline Scenario are shown in **Appendix 5.2**.

(2) O&M Cost Recovery Scenario

The international practice suggests that at least the O&M costs of the sewerage system should be covered by the revenue generated. Considering of this scenario is particularly important for the F/S project because the official policy of the Government of Syria is also aimed at gradual achieving the 100% recovery of the O&M costs for the water supply and sewerage systems.

For the project O&M costs to be recovered through the sewerage charges, the sewerage tariff for domestic customers should be set at the level of approximately 2.4 SP/m^3 (increasing this figure by 10% for conversion of non-domestic tariffs to domestic ones gives the required O&M costs of 2.6 SP/m^3 in the 2008 prices). As there could be an infinite number of splits of the 2.4 SP/m^3 between a variable and a fixed component, it was assumed that the fixed charges were Nil. In no way it means that the fixed charges are recommended to be excluded. This assumption was made under this and the two subsequent scenarios for simplicity only. In reality, the volume-based part of the tariff is expected to be less than 2.4 SP/m^3, taking into account a fixed part of the tariff. However, further elaboration on the recommended split between the fixed and the variable parts of the tariff is beyond the scope of this study.

With the average household water consumption being 20 m^3/month, the monthly sewerage charges under this scenario account for SP 48 (2.4 × 20), which is only 0.2% of the average household income (SP 23,000) - a definitely affordable amount.

The NPV under this scenario is apparently negative and accounts for minus SP 523.2 thousand.

Details of evaluation under the O&M Cost Recovery Scenario are shown in **Appendix 5.3**.

(3) 50% Capital Cost Recovery Scenario

The 50% Capital Cost Recovery Scenario under consideration is the case when the O&M project costs and 50% of the capital costs, as well as the financing costs associated with the latter, are recovered through the sewerage charges. Assuming that 50% of the project capital costs that are funded by the Government represent a grant, the cumulative project cash flows under this scenario should turn to be positive in the year 2025.

For the 50% recovery of the project's capital costs, the domestic volume-based tariff should be set as approximately 5.6 SP/m^3. It would result in the total sewerage charges of 112 SP/month (0.5% of the household income), which is believed to be affordable for an average household.

The NPV under this scenario is still negative and accounts for minus SP 313.6 thousand.

Details of the financial evaluation under the 50% Capital Cost Recovery Scenario are shown in **Appendix 5.4**.

(4) Financial Feasibility Scenario

The last scenario under consideration is the Financial Feasibility Scenario. It is a rather hypothetical case, pertaining to the situation when the F/S project is feasible financially, providing the FIRR of 10% (the assumed opportunity cost of capital).

Using the trial and error method, it can be estimated that for the F/S project to become feasible financially in its strict definition, i.e. when its FIRR is equal to 10% or in other words when its NPV at the discount rate of 10% is Nil, the domestic volume-based tariff should be set as approximately 10.4 SP/m^3. This would result in the monthly sewerage charges of SP 208 (1% of the household income), which can probably be considered as marginally affordable.

Sensitivity of the FIRR to adverse changes in the revenue, capital costs and O&M costs is shown bellow.

Table 7.2.1 Sensitivity of FIRR to Adverse Changes

Adverse change by	10%	20%	30%
Revenue decrease	8.1%	6.0%	3.6%
Capital cost increase	8.7%	7.5%	6.4%
O&M cost increase	9.6%	9.2%	8.7%

The sensitivity analysis demonstrates that the F/S project is very sensitive to adverse changes in the revenue amount and is rather robust to possible increases of the O&M cost.

It must be stressed that the above-quoted figure of 10.4 SP/m^3 should not be misinterpreted. It reflects incremental costs of a particular project and by no means represents the full sewerage cost in the F/S area, nor can be extrapolated to other areas. In particular, the F/S project does not deal with the sewerage network and therefore the full sewerage cost in the F/S area is higher than this figure, because the full cost also includes the capital and O&M costs relating to the sewerage network, as well as a portion of general administration costs like the costs for billing

and charges collection, and so on. It is worth noting that full recovery of capital costs of sewerage projects through user charges is a rare case in the international practice and is not on agenda of the Government of Syria in the foreseeable future.

The NPV under this scenario is Nil by definition.

Details of evaluation under the Financial Feasibility Scenario are shown in **Appendix 5.5**.

(5) Recommended Scenario

A comparison among the four scenarios is schematically shown in **Figure 5.2.1**. The project capital and O&M costs are the same under all scenarios, but the split between the sewerage charges and government subsidies is different, depending on the level of tariff (financing costs were excluded).

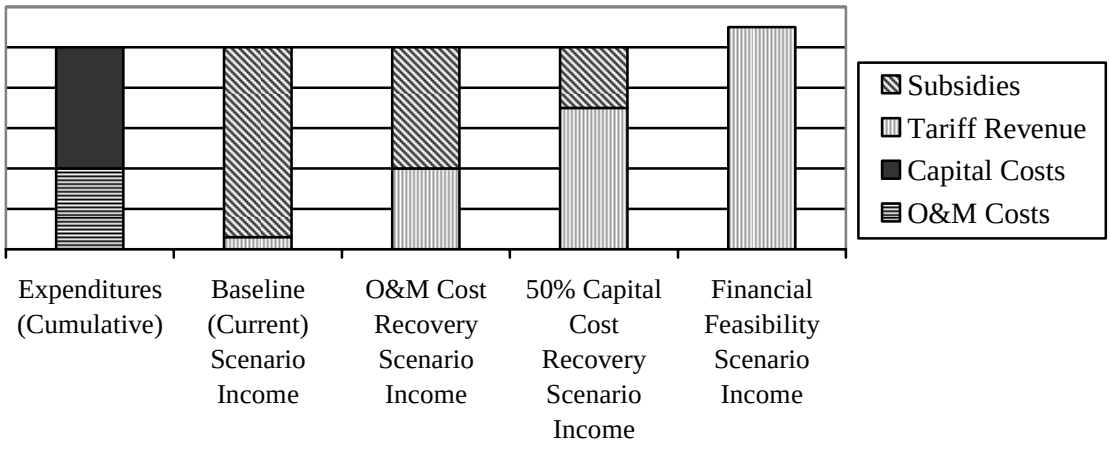


Figure 5.2.1 Comparison of Four Scenarios

Having considered the four above-discussed scenarios, the O&M Cost Recovery Scenario seems to be the most appropriate and could be recommended in the foreseeable future. This choice is justified by the following reasons:

(i) achievement of the O&M cost recovery represents a challenging but attainable target for the Sewerage Company;
(ii) namely the 100% recovery of the O&M costs is on the medium-term agenda of the Syrian Government; and
(iii) this scenario requires only a moderate increase of the tariffs, which can practically be implemented by the Government without serious negative social or political consequences.

The recommended scenario should be valid for a limited period time. Once the 100% recovery of the O&M costs is achieved, a higher-level scenario that assumes for instance recovery of the 50% of capital cost or recovery of the cost of electrical and mechanical equipment will have to be selected.

5.2.5 Outline of the Proposed Financial Plan of the F/S Project

The proposed financial plan for the F/S project is based on the selected O&M Cost Recovery Scenario. As the selected scenario does not require recovery of any capital costs through user charges, the proposed financial plan assumes that all capital costs and possible financing costs should be provided to RDAWSSA/ Sewerage Company as a grant. Practically, the project could be funded either directly from the Public Debt Fund or from proceeds of a loan taken on the international financial markets. In the latter case however, the debt should be served and eventually paid back from the general revenue of the state budget.

At the same time, sound financial management of the F/S sewerage project requires that the revenue generated by the project (sewerage charges) should cover all O&M costs of the project, i.e. O&M of the project should be funded from the internally generated cash. For this purpose, the current sewerage tariffs should be raised upfront to an appropriate level that would reflect the project O&M costs. However, without possibility to set the tariffs at a regional level, the task of matching the tariffs with the O&M cost of one particular project can hardly be implemented in practice.

Refer to **Chapter 8** for further recommendations regarding the financial management.

CHAPTER 6 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

6.1 Social Considerations and Summary of the Results of Social Survey

6.1.1 Social Considerations

(1) Preparation of the 3rd Stakeholder Meeting

In order to ensure that the 3rd Stakeholder Meeting could be conducted effectively, a taskforce for implementing the Stakeholder Meeting was established by MHC in collaboration with the JICA Study Team. The major activities of the taskforce are summarized as **Table 6.1.1**.

Table 6.1.1 The Major Activities at Preparation Period

Activities		Details of Activities
1	Discussion and decision on the date and place of the Stakeholder Meeting.	The Stakeholder Meeting is decided to be held at Bloudan City, considering the accessibility of the stakeholders from Zabadani, Madaya, Bukein and Bloudan
2	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.
3	Discussion on notification methods of the Stakeholder Meeting.	2 weeks ago, the stakeholders are notified by fax, poster, telephone, direct visit etc.
4	Preparation of materials for the Stakeholder Meeting	Preparation of agenda, presentation materials, comment sheet in English and Arabic.
5	Others	Arrangement and preparation of the Stakeholder Meeting's room and equipment etc.

Source) JICA Study Team

(2) Timing and place of the Stakeholder Meeting

Based on the consultation with MHC, 3rd Stakeholder Meeting is held. The details of the Meeting such as the place and timing of the Meeting are showed in **Table 6.1.2**

Table 6.1.2 Timing and Place of the 3rd Stakeholder Meeting

Timing	Place	Target Areas
10:00 – 14:00 20th November 2007	Bloudan Grand Hotel, Bloudan City	Zabadani, Madaya, Bukein and Bloudan

Source) JICA Study Team

(3) Participants of the Stakeholder Meeting

The number and breakdown of stakeholders that participated in the 3rd Stakeholder Meeting are summarized in **Table 6.1.3**. The lists of participants are showed in **Appendix 6**.

Table 6.1.3 Participants of the 3rd Stakeholder Meeting

Category of Participants	Number of Participants
Central ministries, relevant government agencies	12
Local goverments	16
NGOs	5
International organizations/donors	4
University and research institutes	2
Private sector	4
Representative of local residents	3
Media (TV, radio and newspaper etc.)	1
JICA Syrian Office	2
JICA Study Team (including other JICA projects)	11
Others	1
Total	**61**

Source) JICA Study Team

(4) Consultation program

The program of the 3rd Stakeholder Meetings is shown in **Table 6.1.4**.

Table 6.1.4 Program of the 3rd Stakeholder Meeting

Program	Oranization in Charge
Opening Statment	Ms. Tomita Akiko, Resident Representative of JICA Syrian Office
Part I: Outline of F/S on Zabadani Sewerage System	1) Mr. H. Sano, Team Leader, JICA Study Team; 2) Eng. Ghassan Tarboush, C/P of the Project, MHC
Part II: Explanation of the Results of Pre-EIA Level Study	Eng. Thaer Janem, C/P of the Project, MHC
Coffee Break	
Part III: Questions and Answers	All stakeholders
Closing Remarks	Dr. Wassim Fallouh, MHC

Source) JICA Study Team

(5) Main topics discussed

The main topics discussed in the 3rd Stakeholder Meeting and provided in form of comment sheet are summarized as **Table 6.1.5**.

Table 6.1.5 Main Topics Discussed in the 3rd Stakeholder Meeting

Question and Comment		Answer
1	Did you take into consideration the huge increasing of the population during Summer season?	We know that Zabadani Area is the most important site for tourists especially in Summer season and we took this issue in our consideration when we estimated the future population.
2	Are there some STPs in which the same treatment method (OD) is used in Syria?	In Syria, there are not any STPs use the OD method, but we have experiences in Japan, Philippine, India and other countries.
3	In the upper area of proposed STP site, some people are using sewage for irrigation. Can we pump up the treated water to that area?	We studied several alternatives in choosing the STP location and we found the proposed location is the best for reusing the treated water in irrigation. For pumping

Table 6.1.5 Main Topics Discussed in the 3rd Stakeholder Meeting

Question and Comment		Answer
		up the treated water to the upstream area, it is possible in technical, but it is very expensive solution. On the other hand, using raw sewage for irrigation may create damage to soil and agricultural products.
4	Can you explain the reasons why the STP location is changed from Tieba (downstream of the Zabadani Area, EIB proposed site) to the new site?	In EIB study, all wastewaters from Zabadani area will be collected to one central STP which is located at downstream of the Zabadani area. In our opinion, it is better to select the STP location near the existing wastewater discharge point to avoid constructing long trunk sewer, and to provide treated wastewater to the farmers in the same area for irrigation.
5	You know that Zabadani area is a very important tourist area and it is very sensitive to the odor problem. Did you take this problem in your consideration during the design and planning stage? And you know that the wind direction is south east which means that the odor will have negative impact on the whole Zabadani area.	We have given much weight to this problem. 1) Firstly, during planning stage, we selected OD method and mechanical dewatering system, which will make the odor from the STP to be minimum level. 2) Secondly, the distance between the STP and the nearest house is about 100 m, there will not be odor problem considering the situation at exiting STPs using method and mechanical dewatering system. 3) Thirdly, tree belt and buffer zone are proposed to mitigate odor. 4) Finally, in future additional deodorization processes can be applied if necessary.
6	Is it possible to cover the STP completely, as you know the proposed location is inside the future residential expanding area and there are many houses locate near the STP and there is children camp located at 2 km away.	We proposed OD method to treat the wastewater and also we proposed the mechanical dewatering method to treat the sludge which requires special room for operation, which means that we will caver the STP partially. It is possible in technical to cover the STP completely but it cost too much.
7	Did you study other alternatives which take the new communities and future expanding in the consideration, such as decentralized sewerage systems? Did you take in your consideration the earthquake problem in Zabadani area which is considered as active area?	We studied several alternatives and we reviewed all studies which were conducted by other organizations like EIB and MHC. We will take all these suggestions in our consideration and we will include them in our F/S report. MHC took the earthquake problem in the consideration and it will include this matter in details design study.
8	What is final disposal method for dewatering sludge?	There are not isolation systems at existing dumping site to prevent groundwater pollution. In pre-EIA study, we analyzed heavy metals of the sludge of existing STP and soil at Zabadani area. The results of the analysis show a lower level of heavy metals in the sludge and soil, which means that the sludge can be used for agriculture. But we proposed a monitoring system to check heavy metals in sludge and soil.
9	As the Zabadani Municipality, we have three questions: 1) Are there any replacement or rehabilitation plans for our very old sewer network (more than 50 years)? 2) Did you take into consideration for capacity building plan in sewerage sector?	1) We don't have enough time and budget to make detailed survey on all sewer networks in each community, so we only focus on truck sewers. 2) It is very important thing, and MHC will be responsible for this sector. 3) The third point is also very important to create job opportunities for local residents (engineers and

Table 6.1.5 Main Topics Discussed in the 3rd Stakeholder Meeting

Question and Comment		Answer
	3) Did you put any recommendations in your study to employ the local engineers as operation staff in the proposed STP?	other staff), but it is difficult to find qualified staff from the municipalities to STP operation and maintenance.
10	We should prepare general plan for integrated water resources management in Zabadani area, and we should prepare a regional study including the sewerage system, irrigation system for reusing treated wastewater etc. Finally, we should consider leakage problems (sewerage system and water supply system).	We will take all of these points in our consideration.

Source) JICA Study Team

(6) Information disclosure

The minute of the 3rd Stakeholder Meeting is prepared by MHC collaboration with the JICA Study Team, and is available for public viewing at Sewerage Dept. of MHC, Zabadani, Madaya, Bukein and Bloudan Municipalities. The minute is provided in English and Arabic.

6.1.2 Summary of the Results of Social Survey

To grasp the residents' awareness to sewerage and sanitary facility and living sanitary environment, a social survey is conducted by a local consultant. The survey area and the number of respondents are showed in **Table 6.1.6**, and major items of questionnaire are showed in **Table 6.1.7**.

Table 6.1.6 The Survey Area and the Number of Respondents

Area	Sample Size (required at TOR)	Actual Number of Respondent	Remarks
Zabadani	97	101	Based on current population.
Bloudan	11	15	Based on current population.
Bukein and Madaya	42	45	Based on current population.
Downstream of Barada River	50	50	The interviewees should be the farmers who have the farmland.
Total	200	211	

Source) JICA Study Team

Table 6.1.7 Major Items of Questionnaire

Content	Item
1. General information	Address, name, gender, age, the number of family members, occupation, education level, duration dwelling
2. Social-economic characteristics	Housing ownership, average monthly income and expenditure of the household, breakdown of expenditure
3. General information of water supply	Water source, monthly water consumption, opinion on water tariff
4. General information of sewerage system	Destination of sewage, method of sewerage tariff payment, willingness-to-pay for sewerage tariff etc.
5. General information of health and hygiene	Situation of water-borne diseases etc.
6. General level of understanding on the environment	Attitude of environment issues and major pollution sources etc.
7. General information on irrigation and willingness-to-pay for irrigation tariff	Current situation of irrigation for farmland, willingness of irrigation tariff for using treated sewage etc.

Source) JICA Study Team

The results of questionnaire survey are summarized in **Table 6.1.8**.

Table 6.1.8 The Results of Questionnaire

Question Item		Results
1. Number of family members	Persons/each family	5.7
2. Occupation of respondents	Government worker	30.8%
	Agriculture	28.9%
	Commerce	13.7%
	Factory	10.0%
	Private office	9.5%
	Retired	3.8%
3. Education status	Primary school	27.5%
	No education	22.7%
	University	17.5%
	Middle school	13.3%
	High school	13.3%
4. Average income of household	SP/month	23,000
5. Average expenditure	SP/month	25,000
6. Average expense	Food	51.0%
	Health	5.1%
	Electricity	4.8%
	Telecommunication	3.7%
	Water tariff	1.6%
	Sewerage tariff	0.2%
7. Water source	House connection	47.9%
	Water vender	36.0%
	Well	14.7%
8. Place of sewage discharging	Sewer	80.6%
	Septic tank	14.7%
	Open drain or river	4.7%
9. Willingness-to-pay (for sewerage tariff)	Don't want to pay	22.9%
	<50 SP/month	20.6%
	50-100 SP/month	27.1%
	100-200 SP/month	2.9%
	200-300 SP/month	9.4%
	300-400 SP/month	10.6%
	400-500 SP/month	6.5%

Table 6.1.8 The Results of Questionnaire

Question Item		Results
10. Major environmental problems	Surface water pollution	37.0%
	Groundwater pollution	37%
	Solid waste	9%
	Noise	5.7%
	Odor	4.3%
	Air pollution	3.3%
11. Season of irrigation	Summer	89.1%
	Spring	6.3%
	Autumn	4.7%
12. Major water resources for irrigation	Groundwater	66.7%
	River water	25.9%
	Raw sewage	1.9%
13. The rate of farms who want to reuse treated wastewater for irrigation		73.7%
14. Willingness-to-pay (for treated wastewater)	SP/month	425
15. The rate of farms who want to reuse sludge for agriculture		66.7%
16. Willingness-to-pay (for sludge)	SP/month	200

Source) JICA Study Team

6.2 Environmental Impact Assessment on the Priority Project

6.2.1 Description of the Nature and Social Environment

The basic natural and social conditions of Zabadani area are summarized as follows:

Item	Description	
1. Climate (1959-1989)		
1.1 Temperature	The average monthly temperature in Aug. (the hottest month): The average monthly temperature in Jan. (the coldest month):	32.1 ^{o}C 0.2 ^{o}C
1.2 Pressure and wind	The value of atmosphere: Prevailing wind direction: Wind speed:	800-900 hPa SE 1.5-4.5 m/s
1.3 Precipitation	Average annual precipitation:	493 mm/year
1.4 Moisture	High in winter Low in summer	
2. Geology	Neogene period layer	
3. Social conditions	Christian Muslim	7.6% 92.4%
4. Distribution of people (2006)	<15 years old 15 – 45 years old 45-65 years old >65 years old	45.3% 33.0% 16.4% 5.3%
5. Type of industry	Stone, wood, aluminum, water filling etc.	

Source) MHC, Zabadani Municipality

6.2.2 Pre-Environmental Impact Assessment (EIA) level study

For the F/S of Zabadani sewerage system, a pre-EIA level study is conducted. The reason is showed as following:

(1) Considering the fact that Zabadani area is a tourist area and dewatering sludge from the proposed STP may be used for agriculture, more detailed study (comparing IEE level study)

is necessary.

(2) For the technology transfer to C/P of MHC, EIA level study on part of study items (noise and soil pollution) is conducted in accordance with the request of MHC C/P.

(3) However, the study is not conducted at full EIA level study. The pre-EIA study is used at this F/S report.

During the pre-EIA level study, 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.

Ten (10) items concerning social environment, natural environment and pollution aspects are checked and the results of the pre-EIA level study are summarized in **Table 6.2.1**.

Table 6.2.1 Results of the Pre-EIA Level Study on the F/S of Zabadani Sewerage System

No.	Environmental Items	Evaluation		Remarks
		Without Project	With Project	
1	Involuntary resettlement	D	D	Proposed STP site is used as military camp (no any facilities except four buildings). Thus no resettlement will be required.
2	Local economy/land ownership	D	D	Proposed STP site (5.5 ha) is public land (belonging to Ministry of Agriculture). So the ownership of the land will be changed from Ministry of Agriculture to MHC.
3	Traffic	D	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 (100 cars/hr) and the period of impacts will be short. In addition, some measures will be taken during construction period.
4	Cultural heritage	D	D	Based on the information collected and field survey, no valuable cultural heritages at STP site are identified.
5	Water usage and rights	D	D	Proposed STP site is near existing sewage discharge point, the people can use treated wastewater for irrigation. Therefore, no changes for water usage and rights are expected.
6	Water pollution	A	D	Water quality of receiving body will be improved. Moreover, the sludge is proposed for agricultural use, so groundwater pollution by sludge is negligible.
7	Soil pollution	D	C	The results (see **Appendix 6)** of heavy metals analysis indicate that the concentrations heavy metals in the sludge of existing STP and soil at Zabadani area are lower than Syrian sludge disposal standards and soil environmental standards. Therefore, it is proposed to reuse dewatering sludge from the STP for agriculture. However, a monitoring system will be necessary to check the impacts of heavy metals in the sludge on the soil in operation stage.
8	Waste	D	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.
9	Noise and	D	C	Noise and vibration may be generated by construction equipment

Table 6.2.1 Results of the Pre-EIA Level Study on the F/S of Zabadani Sewerage System

		Evaluation		
	Vibration			and vehicles during construction stage. According to the results of field noise survey, the noise levels at the nearest houses are 45 dB(A) and 69 db(A) respectively. It is estimated that during construction stage of the STP, the noise levels at the nearest houses may be increased to be 62 dB(A) and 72 db(A) respectively (see **Appendix 6)**. Therefore, some countermeasures may be necessary. However, the period of the impact is short and no residential area around proposed STP site.
10	Offensive odor	C	C	Odor may be emitted from wastewater and sludge treatment facilities. However, following countermeasures are considered. 1) During planning stage, OD method and mechanical dewatering system are selected to reduce odor level. 2) Tree belt and buffer zone are proposed to mitigate odor. 3) A monitoring system is proposed to check odor during operation of the STP. If it is necessary in future, additional deodorization processes can be applied. In addition, The concentrated residential area is more than 2 km away from the STP site, and the distance between the STP and the nearest houses (4 houses) is about 100 m. Moreover, raw sewage also emits odor. Considering these factors, the impact of odor is considered to be light.

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

Source) JICA Study Team

6.2.2 Recommendation on Countermeasures

In order to mitigate these negative impacts, some countermeasures and recommendations from an environmental viewpoint are given in **Table 6.2.2**.

Table 6.2.2 Recommendations for Zabadani Sewerage System (F/S)

No.	Impact Items	Recommendations for Mitigation Measures on Negative Impacts
3	Traffic	1) To inform the construction plan to local residents before construction of the STP 2) To prepare proper construction schedule and methods of sewers and STP 3) To select reasonable construction time to avoid traffic peak 4) To prepare traffic control plan during construction period
7	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. (proposed monitoring plan is showed in **Table 6.2.3**.)
9	Noise	1) To inform the construction plan to local residents before construction of the STP 2) To select reasonable construction time (holiday and night working should be prohibited) 3) To establish a monitoring system to check noise level at nearest houses during construction of the STP (proposed monitoring plan is showed in **Table 6.2.3**.)
10	Offensive odor	1) To plant a tree belt (about 5 m) around STP site to mitigate odor 2) To set a buffer zone of 100m 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 (proposed monitoring plan is showed in **Table 6.2.3**.)

Source) JICA Study Team

6.2.3 Monitoring Plan

It is recommended to establish a monitoring system to check the impacts on environment during construction stage and operation stage of the proposed projects. Proposed monitoring plan (monitoring points, frequency and items etc.) are summarized in **Table 6.2.3**. Annual cost for implementing the proposed environmental monitoring plan is estimated to be 240,000 SP.

Table 6.2.3 Proposed Environmental Monitoring Plan

Monitoring Item	Monitoring Point	Monitoring Frequency	Monitoring Parameter
During Construction Stage			
Noise at the STP	4 points (2 at STP borderline and 2 at residential area, same as Pre-EIA level study)	1-2 times/week	Equivalent continuous A sound level (L_{aeq})
During Operation Stage			
Heavy metals of dewatering sludge and soil	3 composite samples (1 for dewatering sludge and 2 for soil of agricultural lands where dewatering sludge are disposed)	2 times/year	As, Cd, Cr, Cu, Hg, Ni, Pb, Zn
Odors level around STP	6 points (1 at STP borderline and 5 at the areas where are located at the downwind of the STP)	4 times/year (in each season)	NH_3 and H_2S

Source) JICA Study Team

CHAPTER 7 FORMULATION OF PROJECT IMPLEMENTATION PLAN

7.1 General Budgetary Allocation Procedure for Sewerage Projects

The investment budget of the Ministry of Housing and Construction (MHC) includes the cost of annual investments in water and sewerage projects and estimated funds needed to cover these investments.

Briefly, the general procedure applicable for budgetary arrangements for sewerage projects can be summarized as follows:

1) Technical Departments in MHC estimate their needs and prepare initial plans and estimated budgets based on experience and technical studies. The plans are forwarded to the Directorate of Planning in MHC.

2) The Directorate of Planning receives the plans, revises them and consolidates in an annual Ministry Plan. The consolidated Plan is sent to the State Planning Commission (SPC) of the Ministry of Finance for approval.

3) SPC received the Ministry Plan, revises it in consultations with MHC and the Ministry of Finance, modifies the figures as necessary and sends the approved Plan to the Higher Council for Planning.

4) The Higher Council for Planning received the Plan, reviews it, and issues a decision in which the Plan is approved. The finally decided Plan is sent to MHC for implementation. In exceptional cases, a project not included in the Ministry Plan may be added after getting an approval of the Chairman of the Higher Council for Planning - Prime Minister.

Refer to Chapter 6 of the M/P Report for further details.

7.2 Procuring External Finance (Grants & Loans) for Projects in Syria

When external funds are expected to be procured, the following procedure should be usually followed:

1) SPC addresses MHC for determining the projects that could be proposed for external funding. In turn, MHC informs SPC about the available important projects (for instance, the F/S project) that should be given priority. If there are several projects, they must be prioritized, provided that they are listed in the Ministry Plan.

2) SPC informs the prospective funding institutions that have previously declared their readiness to finance projects in Syria about availability of a number of projects entitled for funding (by grants or/and loans).

   Whereas selection of the prospective funding institutions to be contacted is a prerogative of the Government of Syria, taking into consideration the ongoing projects, the Japan Bank for International Cooperation, the European Investment Bank (EIB), the KfW Investment Bank of Germany, the Export-Import Bank of Malaysia among other donors could be recommended, to mention but a few.

3) The interested granting / lending institutions have to visit MHC for discussions over these projects such as their importance, social, health, economic, environmental and other consequences, etc.

4) After visits to MHC, the granting / lending institutions should select one or more projects according to their priority and send a letter to SPC expressing desire, consent and readiness to finance these projects (extending grants or/and loans). It should be noted that that in Syria, Feasibility Studies are usually financed by grants, whereas supplies - by loans.

   Generally, financing of projects in Syria is carried out by adopting one of the following methods:

   - Local credit extended by the Syrian Government Treasury (Should there be no granting or lending institution, the foreign currency needed for financing the supplies shall be procured from Oil Marketing Office.)
   - External credit provided by the granting or lending institutions
   - Common credit (local and foreign), which is the prevailing method for most of the major projects, where civil works are financed by the local resources (Government of Syria).
   - There are other systems available for financing projects in Syria, particularly Public-Private Partnership (PPP) models like the B.O.T. (“Build, Operate, and Transfer”) system. However, until now, this system has not yet been applied for the sewerage projects and negotiations are going on for adopting this system in the future.

5) MHC is recommended to provide the interested granting / lending institutions with the following information about the prospective projects:

Target and Concept of the Project

The information provided should include the target of the project and solutions expected of this project for solving environmental and health problems in the area that is in need for providing a sewage treatment plant and the treated wastewater for irrigation (Syria is considered as an agricultural country), as well as protecting the surface and ground water from being polluted by sewage. In particular, the number of outlets which discharge untreated sewage in public water bodies such as rivers, pools, dams, etc. or in the agricultural land marshes should be stated. Also, current usage of the untreated sewage for irrigation, which threatens the environment and inflicts resident farmers with health problems, should be mentioned. The civil works, if any, located on the track leading to the main pump plant or to the proposed sewage treatment plant should be stated as well.

General Information about Project

The geographic location and nature of the area to be provided with the sewage treatment plant (agricultural, industrial, etc) should be determined. If the area is agricultural one, the basic product planted should be stated in addition to the climate description (number of summer's months, number of rainy months, average temperature, and average rainfall). Furthermore, the application should include the number of population who shall benefit from this project, the location of the sewage in the area, drinking water networks and resources, wind direction and the body that shall provide O&M of the plant (usually, the sewerage companies).

Strategy and Policy of the Government of Syria for Disposing of Polluted Water

Syria began construction of sewage treatment plants in major cities believing that polluted ground and potable water resources constitute a genuine problem. Particularly, the priority was given to the areas where potable water resources are polluted by sewage. Hence, a comprehensive Syria-wide study covering was commenced for determining investment priorities. However, due to the lack of expertise necessary for building sewage treatment plants, Syria is willing to cooperate with foreign bodies to a large extent, not only in terms of financing relevant projects, but focusing on bringing foreign expertise to Syria. MHC is the body responsible for providing drinking water and disposing of sewage. However, the bodies responsible for maintaining some of the sewerage assets are the Municipal Councils belonging to the Ministry of Local Administration and Environment. With the aim to concentrate all sewage-related affairs in one place, sewerage companies were established in the Governorates where sewage treatment plants were constructed. These companies shall be responsible for sewage collection and treatment (management, operation and maintenance).

Technical Information

- Plant location and closeness to water resources
- Preliminary studies about the plant (number of population, daily average sewage flow, method of treatment, and so on)
- Type of sewage (household, industrial)
- Plant's basic elements (input works, filtrations, initial sedimentation basins, etc)

Financial Information

- Estimated costs for the civil works and supplies
- Financing summary

6) Afterward, SPC shall negotiate with the selected granting / lending institution in respect of the (i) terms of loan, (ii) repayment period, (iii) interest rate, (iv) grace period, etc.

7) Finally, the loan agreement shall be authenticated and signed by the People's Council, and shall be issued as per a decree of the President of Syria.

7.3 Tender Evaluation

The tender evaluation procedures in Syria, that are briefly described below, are regulated by the Contracts Regulations issued as per Law No. 51 for the year 2004, the General Conditions Book of the Unified Contract Regulations issued as per Decree No. 450 for the year 2004, and Legislative Decree No. 54 for the year 2006 which shall be put into effect as from 1 January 2008.

Once the necessary funds are allocated by SPC (local finance, external finance, or common local & external finance), the project shall be announced in the official gazette and advertisement newspaper that shall include the necessary conditions of implementing the project, along with determining the bid bonds, period of advertisement, period of execution, date of submitting offers, conditions of announcement (local or external or both). In the case of local announcement, the allocated funds shall be in Syrian Pound exclusively, in the case of external announcement, the allocated funds shall be stated in Euro, and in the case of mixed local and external announcement, the allocated funds shall be in Syrian Pound for civil works and in foreign currency for supplies.

Before the end of announcement period, the applying body (Ministry) shall form special committees for studying these offers (suggested by the Minister and approved by the Prime Minister): Envelopes Opening Committee (a coordinator among the Ministry, committees and the tenderers), Technical Committee, and Financial Committee.

The Envelopes Opening Committee shall open the envelopes for verifying all documents submitted by tenderers according to the legal and financial conditions, and for completing the missing documents, if any. After verifying completeness of the documents submitted by all tenderers, the technical offers are referred to the Technical Committee.

After receiving the technical offers, the Technical Committee shall study and qualify the tendering companies by setting specific technical points, which shall be determined according to the company's specialty and field of business, capital and experience, number of workers, similar projects executed by the company and their locations, etc. Then, the Technical Committee prepares technical tables relevant to the technical evaluation through determining the detailed technical specifications. Afterward, points shall be calculated and a technical point allocated for each tenderer. A technical report shall then be prepared stating the results of the technical evaluation in order to be referred to the Envelopes Opening Committee for approval and authentication.

After approval of the technical report by the Envelopes Opening Committee, the financial offers are referred to the Financial Committee for study and determining the winning offer, which shall be the offer with the lowest Economic Price. The Economic Price is defined by dividing the financial price by the technical point realized. A report shall be prepared and forwarded to the Envelopes Opening Committee for approval. Finally, the Envelopes Opening Committee prepares a report in which it determines the winning tenderer in order to be referred to H.E. the Minister for approval and initiating the contractual procedures.

The above-discusses procedures for procuring external finance and tender evaluation can be summarized in a schedule showing the expected time for a foreign-funded project development starting from its financing phase till launching its execution. This expected time schedule is presented in **Table 7.3.1**.

Table 7.3.1 Expected Project Schedule from Financing Phase till Launching Execution

Item	Subject	Duration
1	Correspondences between SPC and lending institutions to define important projects and its financing.	1-2 months
2	Correspondences between SPC and lending institutions to the MHC	1 month
3	Visits of lending institutions to MHC for discussions over the importance of these projects and for deciding projects to be financed.	1 month
4	Lending institutions will be provided by the respective public bodies with the full and detailed technical information about the projects suggested for financing in addition to the financial information and needed discussions.	1-2 months
5	Negotiation phase and signing the loan agreement (terms of loan, payment period, etc.).	Not defined [1)]
6	Loan agreement approval and issuing related decree.	1-2 months
7	Announcing the project.	1-2 months
8	Forming the specialized committees for technical and financial evaluation of the offers.	1-2 months
9	Envelopes opening, technical and financial evaluation.	Not defined [2)]
10	Deciding the winning offer and approving the contract by the Minister.	Less than 1 month.
11	Launching project execution.	Not defined [3)]
	Required total time	**Minimum 1 year**

[1)] According to negotiations
[2)] According to corresponding between the committees and tenderers
[3)] Depends upon the execution period
Source) JICA Study Team

CHAPTER 8 RECOMMENDATIONS TO THE SYRIAN WATER SECTOR

8.1 Sewerage System

8.1.1 Improvement and Replacement of Existing Facilities

The Syrian government, through the public water sector, has undertaken a number of sewerage development programs. However, the facilities construction projects were concentrated mainly in the urban areas. There are certain problems that persist which should be addressed prior to the launching of other water infrastructure.

First, this study noted that concrete pipes have been extensively employed in many service areas but the quality of these materials was found to be inferior. Sewage leakage have been detected in many places. Most of the pipelines do not have adequate connection structures and some pipes are not even reinforced by steel bars. Further, the pipe bedding is also inappropriate thus, contributing to the chronic pipe breakage. Some pipes have deteriorated so badly that, in addition to the breakage, caused the roads to sink or collapse. These deteriorated pipes should be replaced based on the order of prority, utlizing other pipe materials are available in Syria in lieu of the traditional concrete pipes.

Highly recommended are Poly-vinyl Chloride Pipe (PVC Pipe) and Poly-ethylene Pipe (PE Pipe). Compared to concrete pipes, PVCs and PEPs are lighter and easier to install. The corresponding pipe connection work is likewise easier to do, and the switch to this kind of material will ensure excellent water-tightness. Such pipe materials may cost a little higher than concrete ones but the increment is negligible when future cost savings are considered.

Second, some STPs are not functioning efficiently, and among these are the Adraa STP in the Damascus Governorate, Debse Afnan STP, Al Mansourah STP and Ma'dan STP in the Raqqa Governorate, and Homs STP in the Homs Governorate. **Table 8.1.1** shows the proposed remedial countermeasures that should be undertaken for the upgrading and maintenance of these facilities.

Table 8.1.1 Proposed remedial Countermeasures for the Existing STPs

Name of STP	Countermeasures
Adraa STP/ Damascus Governorate	Insufficient aeration time in the aeration tank resulted in inefficient treatment function. To compensate for this, the construction of an additional aeration tank or the installation of high-efficiency aeration devices was proposed. Highly concentrated return sludge from the sludge treatment process has been obstructing the proper biological sewage treatment. This is attributed to the inefficient function transpiring in the anaerobic sludge digestion tank. As primary sludge is too concentrated, this might result in improper sludge mixing in the digestion tank. The rehabilitation of the sludge digestion tank is therefore needed. In the future, incoming sewage flow will increase and the generated sludge volume will likewise automatically increase. This will cause a capacity shortage in the sludge drying beds. Therefore, the introduction of a sludge dewatering system shall be examined. When such system is employed, the area occupied by the drying bed can be utilized for facilities that will be constructed in the future. A tertiary treatment facility will also needed to upgrade treated sewage quality.
Debse Afnan, Al Mansourah, Ma'dan STP/ Raqqa Governorate	There are five STPs constructed by turn-key contract between the Syrian governorate and a private company. These STPs were funded by MLAE. After the completion of projects, some O&M engineers were supposed to be assigned to each STP for hands on O&M training activities and to gain experience by working with operators of the private company. However, no such engineers were assigned, leading to the suspension of the plant operations in the three STPs. Raw sewage was therefore discharged into irrigation canals nearby. To optimize the completed STPs, the assignment of O&M engineers to these facilities should be done immediately. Along with this, a human resource development program should be planned and implemented as soon as possible. This is inevitable as many STPs are expected to be constructed in the near future.
Homs STP	The Homs STP has been operational since 1998. Its plant capacity is 133,900 m^3/day, employing the Conventional Activated Sludge Method. There are two lines, called the Sugar Line for sugar industrial wastewater and the Regular Line for domestic wastewater. "The maximum limits of industrial polluters permitted to be discharged to the sewer network" is indicated in Table 3.5 in Main Report. According to this, the maximum limit of BOD is 800 mg/l while that of the sugar line was 914 mg/l in Jan. 2005 (monthly average). As this is apparently in violation of the existing regulation, sugar industries shall be legally obliged to install the pre-treatment facility. As to the legal enforcement of laws and regulations governing industrial development, these are stipulated in Responsibilities and Compensation in Low No.50 enacted in the year 2002.

Third, some pumping stations were left as they are and not installed with the appropriate mechanical and electrical equipment. This is due to the difficulty of equipment procurement and transacting with overseas suppliers. As reliable equipment is not domestically available, they must be imported. In Syria, however, import-export transactions are difficult because of political/institutional restrictions. Nowadays, such restrictions are gradually being relaxed, and equipment installation work can now be contracted out to international contractors. So, it is recommended by this study that equipment installation work for the said PS be contracted out to

a capable international contractor to relieve pressures and delays in project implementation caused by difficulties of supply

8.1.2 Management and Utilization of Asset Data and O&M Records

The insufficiency of data on sewerage management projects has led to inefficient project implementation. Since the MHC has not been capable of the systematic documentation of asset data = information on existing sewerage facilities such as STPs, PS and sewer networks, difficulties were encountered in the preparation of the sewerage development plan. As a consequence, time and cost savings were not realized. Without precise and detailed data on the existing facilities, work cannot proceed properly and promptly, and this may even lead to costly mistakes or accidents. Along with institutional framework restructure in the MHC, a drastic data management system reconstruction is indispensable to future project execution and operation and maintenance of the constructed facilities.

As stated earlier, all information shall be integrated into a "GIS System". The Study Team proposes the construction and build-up of detailed information to be inputted into this system. Added to this, information on O&M activities shall be included as shown in **Table 8.1.2**:

Table 8.1.2 Information on Sewerage System to be input in GIS System

Facilities	Data to be input
Sewer Pipe	Pipe Diameter, Pipe Length, Pipe Invert Level, Flow Direction, Pipe Material, Installation Year, Construction Cost Repair work record: Date, cost, materials, labor and equipment spent Cause of repair
Manhole	Inner Diameter, Depth, Elevation of MH cover, Installation Year, Construction Cost Repair work record: Date, cost, materials, labor and equipment spent Cause of repair
Pump Station	Pump Specifications, Force Main Diameter, Pipe Length, Pipe Material PS Construction Year, Construction Cost Pump Installation Year, Equipment Procurement Cost Repair work record: Date, cost, materials, labor and equipment spent Cause of repair Equipment replacement date
Sewage Treatment Plant	Treatment Capacity, Treatment Method, Constriction Year, Construction Cost Specifications of Mechanical and Electrical Equipment, Equipment Installation Year, Equipment Procurement Cost Repair work record: Date, cost, materials, labor and equipment spent Cause of repair Equipment replacement date

Once these data are fully inputted into the GIS Map, compiled information will prove useful especially in project preparatory work involving the selection of priority areas for sewerage system development. This would be more so because the locations of the existing facilities are clearly indicated. As deteriorated or old facilities can also be precisely located and their

respective ages are also presented in the Map, this will facilitate the prompt and efficient repair and replacement planning for these facilities to go on functioning. **Figure 8.1.1** shows the proposed image of the GIS Map as sewerage system database.

Further, the MHC shall prepare a periodical O&M activity plan for the sewerage facilities listed in **Table 8.1.2** not only for existing but also for newly constructed ones as it will constitute Preventive Maintenance. Such O&M activities including repair work shall be contained in the "Monthly O&M Report" to be accomplished by each Establishment and shall be submitted to MHC headquarter at the end of every month in digital file. The MHC headquarter shall prepare the report format in digital file and distribute this to all Establishments for their compliance. The report shall record all O&M activities that were executed during a particular month, and reflect the total amount of cost, materials, labor and equipment spent for monthly activities. With these reports for their monthly database, the MHC headquarters can then evaluate the efficiency of O&M activities in each Governorate and act to resolve issues pertinent to each.

MHC shall construct and disseminate the GIS Map Information System and the Monthly O&M Report to authorities and designated audiences countrywide for appropriate, time-saving and cost-efficient project execution and the smooth performance of sustainable O&M activities.

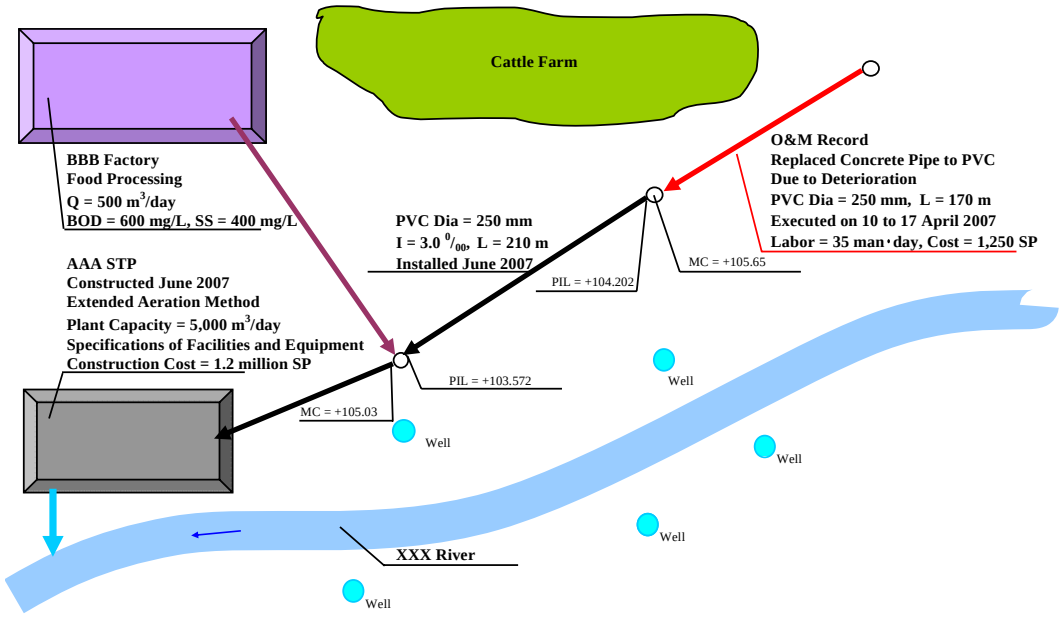


Figure 8.1.1 Proposed Image of GIS Map as Sewerage System Detabase

8.1.3 Environmental and Water Quality Monitoring

As frequently noted, the fragmented and overlapping task assignments among several and related ministries in Syria made the execution of sewerage projects quite ineffective.

In the pursuit of "The Capacity Development of Environmental Monitoring" project supported by JICA, laboratories have been installed in 14 General Commission of Environmental Affairs (GCEA) under MLAE. Just like the jurisdictional arrangement of the MHC in sewerage system development and project implementation, the task of environmental and water quality monitoring shall be entrusted to the MLAE.

MHC shall share the GIS Map Information Database with the MLAE since the map will aid in water quality monitoring. The MLAE can prepare the periodical water quality monitoring plan based on this GIS Map that pinpoints the location of existing sewerage facilities and potential pollution sources such as factories. The MLAE can input its monitoring results on the Map. MHC can also monitor the operations of the sewerage facilities based on the water quality monitoring results. **Table 8.1.3** shows the projects proposed for MLAE in 10th Five Year Plan.

Table 8.1.3 Projects proposed for MLAE in 10th Five Year Plan

No.	Proposed Projects	Budget	Year of Execution
1	Create a general directorate (or body) for regional and urban planning	300 mil SP	2-4 years
2	Establish the national council for regional and urban planning	25 mil SP	1-4 years
3	Studies on project development in Damascus and Aleppo and limiting their expansion	200 mil SP	2007 to 2008
4	Studies on creating alternative cities and new small cities (5 cities)	200 mil SP	2007 to 2008
5	Studies on the development of existing small and medium cities (30 cities)	450 mil SP	2007 to 2010
6	Studies on random cities (10 areas)	200 mil SP	2007 to 2010
7	Studies on developing northern governorates	90 mil SP	2007 to 2010
8	Studies on developing Al Qunetra governorates	40 mil SP	2007 to 2008
9	Studies on local urban balance	100 mil SP	2007 to 2010
10	Information system development	72 mil SP	2007 to 2010
11	Planning of city centers and development centers	100 mil SP	2007 to 2010
12	Directive photographing	80 mil SP	2007 to 2010
13	Topographic survey	423 mil SP	2007 to 2010
14	Map Rehabilitation for the Use of GIS and Satellite Images	60 mil SP	2007 to 2010
15	Digitizing topographic plans and integrating them with real estate and organizational maps	90 mil SP	2007 to 2010

Some outputs of the listed projects, namely No. 10 and 14 seem quite useful in sewerage system planning and, therefore, MLAE should share these valuable data with MHC. As to the details of the 10th Five Year Plan prepared for MLAE, refer to **Appendix 8.1**.

According to the interview with the Director of the Survey Department of MLAE, plans are underway for the establishment of a "Web-GIS Data Center" that will build and process spatial data all over Syria in consonance with the initiatives of project No.10 under "The Information

System". The data will be made available through a web-site.

Such inter-Ministry cooperation and mutual exchange of available information is indispensable for the smooth and efficient project implementation. The Japanese Technical Assistance Program can assist in the production of an efficient data management program.

8.1.4 Introduction of Appropriate Technology

Table 8.1.4 shows the current operational status of the existing STPs.

Table 8.1.4 Current Operational Status of existing Sewage Treatment Plants

Governorate	Name of STP	Plant Capacity (m^3/day)	Treatment Process	Current Operational Situation
Hassakeh	Ras Al Ayn	2,130	Aerated Lagoon Method	Fairly good but plant expansion is needed to cope with incoming wastewater flow growth
Raqqa	Debse Afnan	1,000	Extended Aeration Method	Operation suspended Lacking administrative & technical staff
	Al Mansourah	1,000	Extended Aeration Method	Operation suspended Lacking administrative & technical staff
	Sabkha	1,000	Extended Aeration Method	Fairly good
	Ma'dan	1,000	Extended Aeration Method	Operation suspended Lacking administrative & technical staff
	Al Karameh	1,000	Extended Aeration Method	Fairly good
	Thawra	Unknown	Natural Wet Land Method	Excellent. Treated wastewater is clear and odorless.
Rural Damascus	Qara	600	Stabilization Pond Method	Reportedly unfavorable
	Harran Al Awameed	300	Constructed Wet Land Method	Excellent. Treated wastewater is clear and odorless.
Aleppo	Aleppo	345,600	Aerated Lagoon Method	Inferior as incoming wastewater is highly concentrated
Hama	Salameih	7,000	Stabilization Pond Method	Fairly good and plant expansion work is now on-going
Homs	Homs	133,900	Activated Sludge Method	Unfavorable since incoming industrial wastewater is extremely concentrated
Damascus	Adraa	485,000	Activated Sludge Method	Unfavorable due to insufficient aeration time and inferior performance of sludge digestion tank

Apparently, most of the general biological treatment that transpired in mechanical units, such as the Extended Aeration Method or the Activated Sludge Method have displayed inferior performance. This is due to several factors, namely highly concentrated incoming wastewater, low temperature that significantly affects the biological treatment performance and so on.

However, the biggest factor is the lack of appropriate and sustainable O&M activities. Once an STP is constructed, a properly conducted O&M program should start immediately as this is indispensable to the maintenance of the facility and the implementation of treatment processes. Given the current technology level of the MHC, it cannot afford treatment methods that require

complicated O&M skills. Therefore, only those treatment methods that can be operated and maintained by staff under this current technology level shall be adopted.

As shown in the table, two Wet Land Systems have been operated quite well. The Wet Land System does not require any complicated O&M skill and its construction cost is remarkably low compared with that of general biological treatment applying mechanical units. Treatment performance is satisfactory as well. The Wet Land System has an equally efficient cost structure.

Aside from the Mediterranean Coastal Area, precipitation is generally scarce in Syria and therefore, farmers have a high demand for treated wastewater as their irrigation water source. In planning treatment courses for wastewater re-use, the wastewater will be treated at the point nearest its generating area. In short, the STP shall be planned near the target service area. Plant scale will be "small" as it will serve only those areas close to it, and deliver treated wastewater to the nearby farms. This system will be referred to as the "Small Sewerage System", hereinafter.

The Syrian sewerage sector is apt to prefer the large-scaled Centralized System but the construction of trunk sewers that are lengthy and STPs with large plant capacities will take a longer period of time to complete and an enormous budget to implement. During the said construction period, public water contamination may be further accelerated. In terms of treated wastewater re-use, this will only be available downstream of the STPs. In one report, farmers upstream of the STP broke the trunk sewer running close by for the purpose of drawing raw wastewater for their irrigation use.

Compared to the large-scale Centralized System, Small Sewerage Systems can be constructed in a much shorter period of time with a much lower budget. It is facilitative of treated wastewater re-use because of their accessibility to the farm. The Small Sewerage System is one solution for that can be provided for areas requiring proper wastewater treatment and re-use of treated wastewater.

As the Wet Land System requires no complicated O&M skill and its construction cost is remarkably low, this treatment method is applicable in those areas.

The MHC entered into a contract with GTZ to construct a small-scale treatment facility applying Wet land System through a Debt Swap Loan System. The construction of 20 facilities was proposed mainly for the in-land Governments where the demand for the re-use of treated wastewater is quite high.

Through this project, documents, drawings and records prepared in the design stage,

construction stage and O&M stage shall be properly accumulated and stored in the form of digital data. The gathering and storage of technical data is badly needed by MHC. Accumulated data will classify local information secured from the service area such as incoming wastewater quality and treatment efficiency. Based on these valuable data, further treatment process modification shall be conducted.

The Study Team held several meetings with the stakeholders, the Ministry and Governorate officers. These meetings revealed that the biggest concerns were "Odor" and "Treated Wastewater Re-use". The latter can be solved by the introduction of the Small Sewerage concept. In dealing with the odor problem, the authorities were informed that as long as wastewater is fully oxidized, odor will not be as intense. Stakeholders also manifested a strong interest in the odor problem but very few of them have actually visited an STP. The problem therefore was not so much the odor as the negative public perception of the STP.

To convert such negative image into a positive one, an educational campaign will be most opportune. Wastewater is generated by the people themselves. It becomes MHC's role to show them how public water bodies should be preserved and protected from contaminants from the wastewater that they generate that is not properly treated. The MHC must additionally advise them of the important role that the sewerage system plays in the protection of their sanitary environment and the preserving of their surrounding aquatic system.

STP visitations may also prove informative to the people and aid in the public information campaign. As the Wet Land System as appears to be the most applicable treatment process in Syria for the time being, the MHC can plan STP visitations to the existing two facilities in Rural Damascus Governorate and Raqqa Governorate.

Stakeholders' awareness of the importance of sewerage facilities will improve dramatically through this campaign. This will likewise contribute to the smooth implementation of the project particularly during the site acquisition stage when popular mandate and support is needed.

8.2 Institutional Development

The Study Team, after a thorough assessment and analysis of the institutional needs and requirements of the sewerage system O&M in Syria, is pleased to offer the following recommendations to the Syrian water sector:

- Establish a PMU under the structure of RDAWSSA to implement the F/S project.
- Take practical measures to set up the Sewerage Company under RDAWSSA with an Operations Center in Zabadani for the O&M of the sewerage system upon the F/S

project completion.

- Include the Organizational Development as a component of the F/S project to enhance the capacity of the PMU and RDAWSSA / Sewerage Company staff, starting with a Training Needs Assessment of the relevant staff. Utilize all other means available for staff capacity building, including the extension of various technical assistance programs.

8.3 Financial Management

Based on the financial evaluation of the F/S project (see Chapter 7), the following recommendations are offered:

- A modern financial management system should be implemented in RDAWSSA and its Sewerage Company, including sub-systems for accounting, budgeting, cost & management accounting, and so on.
- The capital costs for the F/S project, along with the related financing costs, should be granted to RDAWSSA / Sewerage Company by the Government of Syria or other donors.
- Recovery of the sewerage O&M costs through sewerage charges should be set as a target to ensure the financial sustainability of the project through the foreseeable future.
- In order to achieve 100% recovery of the O&M costs upon project completion, it was roughly estimated that the existing domestic sewerage charges should be raised to the current price levels, to approximately 2.4 SP/m^3, including fixed fees. Also, it is necessary to decide how this amount can be incorporated in the tariff table and how it can be split between the volume-based and the fixed components of the tariff.
- Regionalization of sewerage tariffs is advisable due to the different conditions prevailing in the different areas.
- Once 100% recovery of the O&M costs is achieved, the next level target (for instance recovery of the 50% capital cost or recovery of the electrical and mechanical equipment costs) will have to be set.
- The tariffs should be regularly adjusted for inflation.
- The practice of using cross-subsidies from non-domestic (particularly from the tourism sector) to domestic customers should be continued. Use of cross-subsidies from the water supply revenue to the sewerage system could also be considered in the future.