

Table 5.2-1 Groundwater Monitoring Stations

No.	Sub-basin	Basin Name	X ¹	Y ¹	Z ²	Geology ³	Type ⁴	Priority	No.	Sub-basin	Basin Name	X ¹	Y ¹	Z ²	Geology ³	Depth ⁵	Priority
1	5	Kebr	181,501	297,758	20	QA/Ba	A(100)	1	47	1	Kebr	200,853	278,067	1,700	C ₂ /C ₁	350	4
2	9	Ostune	181,128	295,271	21	QA/Ba	A(100)	1	48	2	---	204,425	284,368	1,250	C ₄₅	150	4
3	13	Akar	178,268	287,850	40	QA/Ba/C ₄₅	B(50,150)	1	49	3	---	209,732	294,400	780	C ₄₅	100	4
4	17	Bared	174,827	281,010	150	ML/C ₄₅	B(50,200)	1	50	6	Ostune	199,161	285,239	1,250	C ₄₅	500	4
5	22	Abou Ali	166,828	273,134	100	a/ML/C ₄₅	B(100,200)	1	51	7	---	199,990	290,918	600	C ₄₅	500	4
6	26	Jouz	152,358	257,132	400	C ₆ /C ₄₅	B(50,250)	1	52	10	Akkar	192,155	284,763	700	J	400	4
7	30	Ibrahim	147,820	236,648	700	C ₄	A(500)	1	53	11	---	185,978	285,321	420	C ₄₅	250	4
8	33	Kelb	146,155	222,671	400	J ₆	A(350)	1	54	15	Bared	187,346	275,538	1,200	J	1,000	4
9	37	Beirut	133,000	216,500	40	q/C ₂	A(100)	1	55	20	Abou Ali	174,827	255,599	1,300	C ₂ /B/J	D>500	4
10	41	Damour	126,367	195,347	250	C ₄	A(250)	1	56	23	Jouz	168,982	250,500	1,530	J	D>500	4
11	45	Awali	120,933	181,839	250	C ₆	A(300)	1	57	24	---	163,261	250,624	1,350	B/J	D>500	4
12	48	Saintaniq	117,549	175,531	200	E ₂ /C ₆	B(50,150)	1	58	34	Beirut	151,448	214,151	1,200	J	D>500	4
13	51	Zahrani	115,857	171,138	180	E ₂ /C ₆	A(150)	1	59	35	---	141,942	212,634	700	C ₁ /J	300	4
14	53	A. Asoud	108,411	161,611	150	E ₂ /C ₆	B(50,150)	1	60	38	Damour	150,804	205,836	1,250	J	D>500	4
15	58	Litani Upper	180,068	218,451	880	n2	A(100)	1	61	39	---	141,821	201,815	900	C ₁₂ /J	450	4
16	60	Litani Middle	155,578	195,400	830	q5	B(100,200)	1	62	43	Awali	139,653	185,775	1,100	C ₁ /J	D>500	4
17	64	Litani Lower	109,793	155,120	180	C ₄₅ /C ₆	B(50,200)	1	63	46	Saintaniq	131,110	174,552	1,000	J	300	4
18	69	Assi	207,285	255,090	850	q/n	A(100)	1	64	47	---	124,912	173,966	400	C ₆	100	4
19	73	Hasbani	137,601	152,314	600	C ₄	B(100,200)	1	65	49	Zahrani	132,953	170,364	950	C ₁	450	4
20	75	Olient	179,221	291,788	25	QA/Ba	B(50,150)	2	66	50	---	123,572	167,307	350	C ₄	150	4
21	78	Abda	175,532	286,897	15	QA	A(100)	2	67	52	A. Asoud	118,839	159,182	500	C ₄	100	4
22	80	Minie	168,857	281,508	20	qd/m2	B(50,200)	2	68	61	Litani L	133,497	163,370	700	E	100	4
23	83	Chekka	156,753	264,801	300	E/C ₆ /C ₄	B(50,300)	2	69	62	---	125,875	139,290	800	E	300	4
24	86	Batroun	145,974	250,127	450	m/C ₄	B(50,500)	2	70	95	Sour	116,704	130,862	700	C ₄	300	4
25	88	Jounie	144,428	232,377	400	C ₄	A(400)	2	71	96	---	111,782	138,368	450	C ₄	150	4
26	91	Aaramoun	128,943	212,369	50	qd/E/C ₄	B(100,200)	2	72	58/69	Litani/Assi	188,300	225,900	1,005	q/C ₄	500	4
27	92	Barja	123,781	189,670	400	C ₄	A(400)	2	73	56	Litani U	190,524	217,028	1,400	C ₄	200	4
28	94	Sarafand	111,934	168,249	170	E ₂ /C ₆	B(50,200)	2	74	57	---	172,800	222,851	1,300	C ₄	200	4
29	97	Sour	106,894	145,069	150	E ₂ /C ₆	B(50,200)	2	75	59	Litani M	151,400	201,815	1,250	J	500	4
30	98	Yammounne	186,910	256,173	1600	q/C ₃₄	B(50,700)	2	76	58/60	Litani U/M	163,500	201,700	860	q/E	300	4
31	4	Kebr	198,497	296,763	355	Ba	B(50,250)	3	77	60L	Litani M	142,000	166,800	660	J	100	4
32	8	Ostune	191,823	293,032	300	Ba	B(50,250)	3	78	67	Assi	215,388	249,816	1,400	C ₄	200	4
33	12	Akar	181,252	285,902	300	P/C ₄₅	B(50,150)	3	79	68	---	203,123	258,522	1,300	C ₄	300	4
34	16	Bared	180,465	277,279	500	C ₄₅	A(500)	3	80	69U	---	199,000	242,100	990	q/C ₄	300	4
35	21	Abou Ali	170,806	289,237	700	C ₄	A(500)	3	81	69L	---	220,500	278,100	660	q/C ₄	200	4
36	25	Jouz	157,830	253,194	800	C ₄	A(400)	3	82	71	Hasbani	155,134	166,982	1,300	J	150	4
37	29	Ibrahim	156,426	237,465	1000	J ₆	A(500)	3	83	99	K. Kapuk	166,154	177,197	1,150	J	150	4
38	32	Kelb	155,578	224,650	1500	C ₁ /C ₂	A(500)	3									
39	36	Beirut	135,500	214,000	320	C ₂ /J	B(100,200)	3									
40	40	Damour	133,026	195,439	700	C ₄	A(400)	3									
41	44	Awali	130,105	183,975	650	C ₄	A(100)	3									
42	63	Litani Lower	125,289	151,016	450	e2/C ₂ /C ₄	B(50,150)	3									
43	72	Hasbani	150,138	168,855	850	mcg/J	A(150)	3									
44	Beirut	Mid town	129,000	217,000	50	qd/m2a	A(50)	3									
45	Tripoli	Mid town	161,000	277,500	15	a/m2	A(50)	3									
46	Saida	Mid town	116,500	181,200	25	q	A(50)	3									

*1. UTM cord by 1/50,000 Topomap.

*2. Read from 1/50,000 Topomap.

*3. Read from 1/50,000 Geological map.

*4. Type A= 1 OW, Type B= 2 OW.

*5. Required depth estimated (A type).

5.3 Water Quality Observation and Monitoring Plan

(1) Current Issues related to Water Quality Monitoring Management

1) Institutional and Administrative Issue

The Environment Law No. 444 was enacted in July 2002 for the purpose of environmental protection/reservation including water pollution. The law regulates not only the protection of the public water body but also the penalty clauses for the case that effluent polluters such as factory and wastewater treatment establishment discharge the wastewater exceeding the effluent standards. The law, however, has just been approved/enacted in the parliament and has not yet fulfilled its original tasks because of the administrative malfunction of the central government.

Ministry of Environment (MOE) is the main organ which should control water pollution nationwide in Lebanon. However, the ministry has the following administrative problems to implement its function for water monitoring.

- Lack of human resources for the water quality monitoring
- Unorganized inspection system for the water quality monitoring
- Insufficient budgetary allocation to implement water quality monitoring management
- No database of water quality monitoring data/information
- No actual implementation of nationwide continuous water quality monitoring program

Actually, the inspection for the wastewater from the factories and wastewater treatment facilities has not been carried out by MOE. The requirement regulated in the Law has not been put into practice.

2) National Plan/Study

A national plan related to water quality monitoring management has not been prepared in Lebanon. However, the following studies related to water quality monitoring were conducted by the international donors.

- Environmental Master Plan for Litani and Lake Qaraun Cacthment Area” by SIDA (MVM Consultant AB, 2000)
- “Coastal Pollution Control and Water Supply Project” (World Bank, 1997)
- Inception Report prepared by LEDO (The Lebanese Environment and Development Observatory) (Ministry of Environment, 2002)

SIDA (MVM Consultant AB) conducted the environmental survey including water quality for the study area of the upper Litani and Qaraun Lake. However, the study did not mention the water quality monitoring management.

The World Bank conducted the study on coastal water pollution and water supply projects for the major target areas of Kesroun, Saida, Sour and Nabatiye. They stated only the environmental management plan for the project during the construction and operation stage, but did not provide the nationwide water quality monitoring management plan as well as SIDA.

LEDO (The Lebanese Environment and Development Observatory) was financed by EU (European Union) and was incorporated with the study of CAMP (The Coastal Area Management Programme). The study aims at the acquisition of environment-related data, reduction of awareness gap among the stakeholders and system development for the continuous monitoring. CAMP projects, on the other hand, provide the development and management plan as a part of UNEP Mediterranean Action Plan for the sustainable management in the coastal areas of South Beirut, Damour, Sarafand and Naqoura located in South Lebanon. However, the overall management plan for water quality was not mentioned.

(2) Proposed Water Quality Monitoring Plan

1) Purpose of Water Quality Monitoring

The measures for the water pollution will comprise two aspects, namely, one is the measure by developing the environment-related facilities such as wastewater treatments and another is the measure by the knowledge-base development such as development of monitoring system.

The monitoring should fulfill its function for the administrative enforcement for controlling the water quality based on the regulated law or environmental/effluent standards. The administrative force should be resorted when the effluents from the establishments exceed the standards based on the inspections or the water quality of the public water area exceeds the environmental standards.

The water quality monitoring should have the following purpose;

- Protection of water body from water pollution
- Minimizing water pollution at the point sources
- To assess the compliance with the clauses regulated in Law 444
- Implementation of continuous monitoring of water quality of the public water body and the wastewater from the factories and wastewater treatment facilities
- Development/Construction of water quality monitoring database
- Sustainable activity of fishery
- Support of fish life, bathing water, etc.
- Reinforcement of public awareness by disclosing of water quality database

1) Basic Requirement for Water Quality Monitoring Management

a) Basic Requirement for Water Quality Monitoring

As said before, the water quality monitoring will be one measure for conservation of water quality. In order to implement the water quality monitoring, the basic requirement should be established in various aspects. The following frameworks should be provided for the water quality monitoring management;

- Extension of knowledge/awareness for water quality monitoring
- Provision of basic policy on water quality monitoring
- Planning, construction, operation and maintenance of water quality monitoring equipment/devices
- Budgetary allocation for planning, construction, operation and maintenance of water quality monitoring
- Establishment of departments/division for water quality monitoring in central/local government levels
- Establishment of inspection organ for the establishments of factories or domestic wastewater treatment plants
- Establishment of inspection organ of operation of solid waste disposal sites
- Cooperation with international agencies for the common purpose of the preservation of the closed water area such as the Mediterranean Sea

b) Target of Water Quality Monitoring

The water quality monitoring should be conducted for the water area nationwide. The target for water quality monitoring shall be as follows.

- Public water area of rivers, sea and springs
- Wastewater from factories and domestic wastewater treatment facilities
- Treated water of water treatment facilities

c) Proposed Station for Monitoring

The monitoring stations should have the following requirement;

- The points which can identify the state of water pollution
- The areas of rivers, lake and coastal areas which have been identified as hot spots with respect to water pollution by the existing reports ("Assessment of the State of the Environment" or Inception Report of LEDO prepared by MOE)
- At least 1 point for main 17 rivers in Lebanon
- The areas which have high naturalness such as Yammoune or Ammiq wetland
- The areas which can share other data such as hydrological data through network systems

The followings monitoring stations shown in Table 5.3-1 are proposed based on above requirement;

Table 5.3-1 Proposed Stations for Water Quality Monitoring

Name of Water Body	Number of Sampling Point		
	Sampling Point		Total
1. River	Downstream	Middle Reach	
Nahr el Kebir	1		1
Nahr Ostuene	1	1	2
Nahr Arka	1		1
Nahr el Bared	1	1	2
Nahr Abou Ali	1	1	2
Nahr el Jouz	1	1	2
Nahr Ibrahim	1	1	2
Nahr el Kelb	1	1	2
Nahr Beirut	1	1	2
Nahr el Damour	1		1
Nahr el Awali	1		1
Nahr Saitaniq	1		1
Nahr el Zahrani	1		1
Nahr Abou Assouad	1		1
Nahr el Litani	1	4	5
Nahr el Hasbani	1	1	2
Nahr el Assi	1	1	2
Sub Total	17	13	30
2. Lake	River Inflow	Mid of Lake	Outlet to River
Qaraoun Lake	1	1	1
Sub Total	1	1	1
3. Coastal Water			
Tripoli		1	
Batroun		1	
Jbail		1	
Jounie		1	
Beirut		2	
Damour		1	
Saida		1	
Sarafand		1	
Sour		1	
Sub Total		10	
4. Spring Water			
Ral el Assi		1	
El Yammoune		1	
Afqa		1	
Chekka Bay		1	
Jeita		1	
Chtaura		1	
Chamsine		1	
Anjar		1	
Ammik		1	
Ain Zerka		1	
Wazzani		1	
Ras el Ain		1	
Sub Total		12	
Total		61	61

d) Proposed Organization for Water Quality Monitoring

MOE should conduct continuous monitoring for public water area and wastewater from factories and domestic wastewater treatment facilities. It is advisable that MOE should establish the Water Quality Monitoring Department to monitor the water quality or inspect the wastewater from above establishments. As for the drinking water, MOPH (Ministry of Public Health) should conduct the inspection

for raw water and treated water of the purification plants. The proposed organization and execution procedures for water quality monitoring management scheme are shown in Figure 5.3-1, 5.3-2 and 5.3-3.

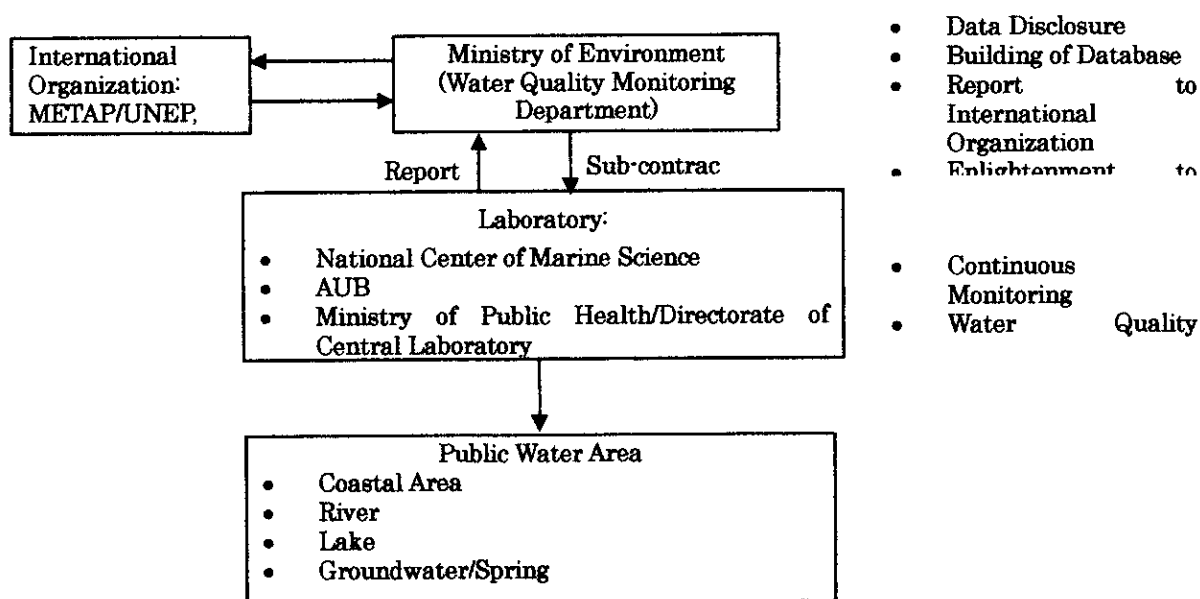


Figure 5.3-1 Proposed Organization for Public Water Area

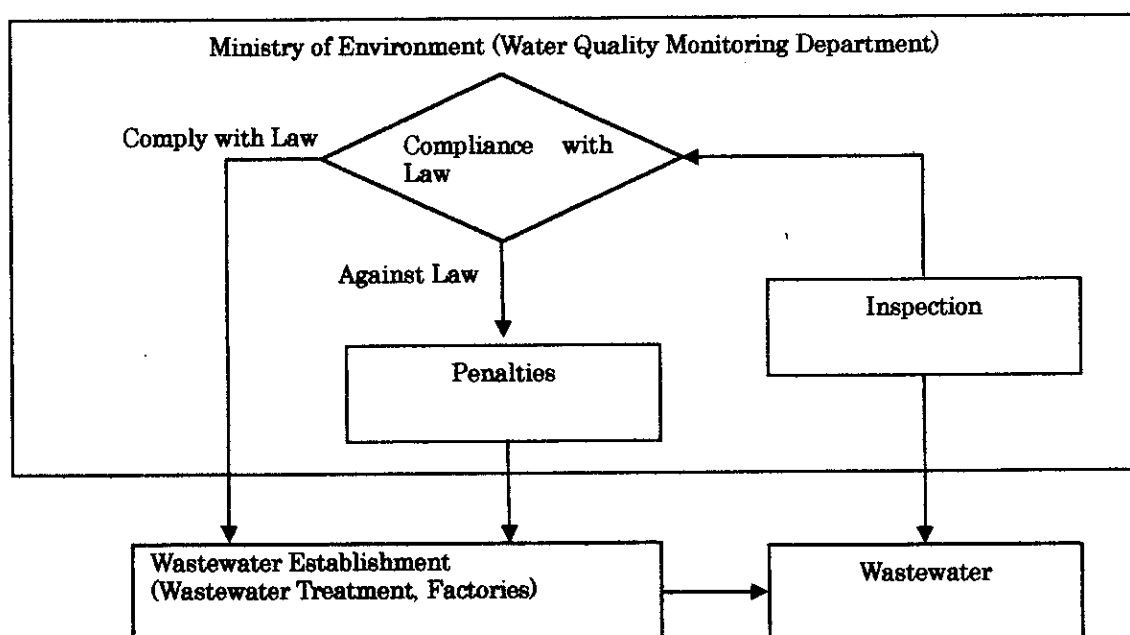


Figure 5.3-2 Procedures for Water Quality Monitoring Management for Wastewater

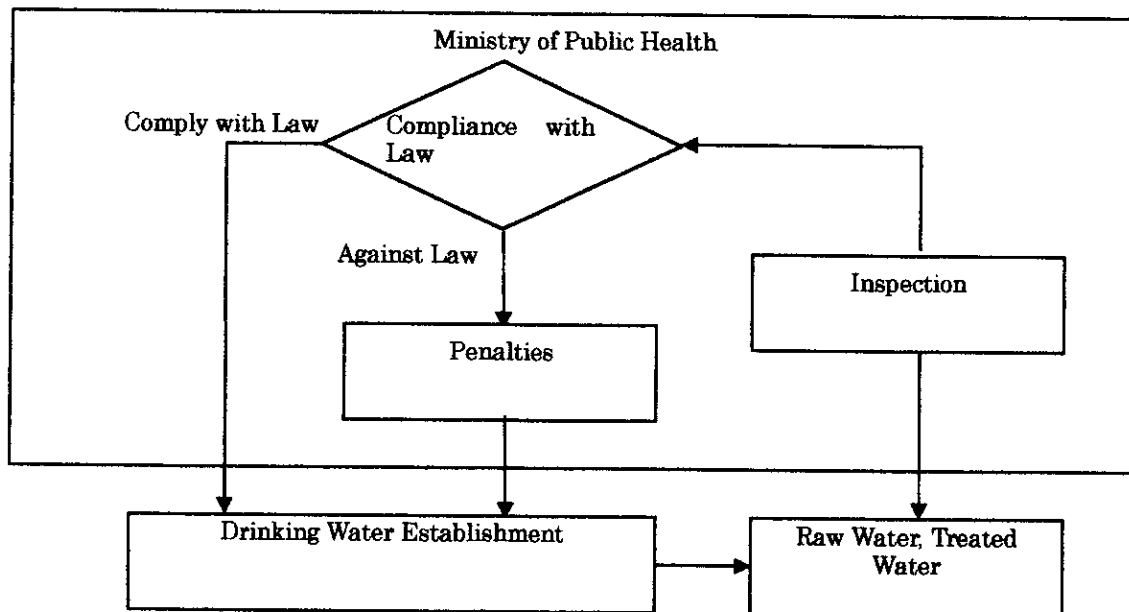


Figure 5.3-3 Procedures for Water Quality Monitoring Management for Drinking Water

e) Monitoring Parameters and Frequency

The parameters for water quality monitoring should be based on Lebanese standards.

Therefore, the following parameters for water quality monitoring are proposed in Table 5.3-2 for the public water area, wastewater and water source for water supply. The frequency for water quality monitoring is also proposed as monthly.

Table 5.3-2 Proposed Monitoring Parameters for Public Water Area

Target Area		
Public Water Area	Wastewater	Water Sources for Water Supply
1. For Rivers, Lakes and Springs		
pH	pH	pH
Electric Conductivity	Electric Conductivity	Electric Conductivity
BOD (excluding lakes)	BOD (excluding lakes)	Salinity
COD (excluding rivers and springs)	Oil and Grease	Alkalinity
DO (Dissolved Oxygen)	Total Suspended Soil	Total Coliform
Oil and Grease	Total Coliform	Fecal Coliform
Total Suspended Soil	Fecal Coliform	Phosphate
Total Coliform	Nematode eggs	Ammonia
Fecal Coliform	Phosphate	Nitrate
Phosphate	Ammonia	Nitrites
Ammonia	Nitrate	Chlorides
Nitrate	Fluoride	Calcium
Fluoride	Sulfate	Magnesium
Sulfate	Sulfide	Sodium
Sulfide	Chlorine	Potassium
Chlorine	Phenols	Fluoride
Phenols	Arsenic	Sulfate
Arsenic	Cadmium	Iron
Cadmium	Chromium	Herbicide and Pesticides
Target Area		
1. For Rivers, Lakes and Springs (Continued)	Wastewater	Water Sources for Water Supply
Chromium	Copper	Silver
Copper	Iron	
Iron	Lead	
Lead	Selenium	
Selenium	Silver	
Silver	Zinc	
Zinc		
2. For Sea Water		
pH		
COD		
DO		
Oil and Grease		
Total Coliform		
Fecal Coliform		

f) Data Management

At present, the database of water quality monitoring has not been prepared. MOE should develop/build the database system of water quality monitoring which can be easily accessed by the public. All monitoring data for the target areas should be collected, rearranged and input into the database. MOE also should provide the assessment report for the attainment of water quality standards for all water body types and effluents. The data/information should be prepared in GIS system to be spatially and in time-series.

Literature Cited

MVM Consultant AB. (2000). Environmental Master Plan for Litani and Lake Qaraun Catchment Area.

The World Bank. (1997). Coastal Pollution Control and Water Supply Project.

Ministry of Environment. (2002). Inception Report prepared by LEDO

