BASIC DESIGN STUDY
ON
THE PROJECT FOR THE DEVELOPMENT OF HYDROLOGICAL AND METEOROLOGICAL OBSERVATION NETWORK IN SYRIAN ARAB REPUBLIC

August 2003

JAPAN INTERNATIONAL COOPERATION AGENCY

PACIFIC CONSULTANTS INTERNATIONAL

PREFACE

In response to a request from the Government of Syria Arab Republic, the Government of Japan decided to conduct a basic design study on the Project for the Development of Hydrological and Meteorological Observation Network and entrusted the study to the Japan International Cooperation Agency (JICA).

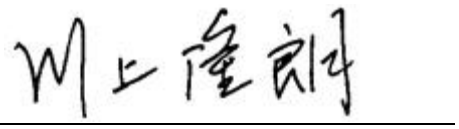
JICA sent to Syria a study team from February 24 to March 21, 2003.

The team held discussions with the officials concerned of the Government of Syria, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Syria in order to discuss a draft basic design, and as this result, the present report was finalized.

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

I wish to express my sincere appreciation to the officials concerned of the Government of Syria Arab Republic for their close cooperation extended to the teams.

August 2003



Takao Kawakami
President
Japan International Cooperation Agency

August 2003

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for the Development of Hydrological and Meteorological Observation Network in Syria Arab Republic.

This study was conducted by Pacific Consultants International, under a contract to JICA, during the period from February, 2003 to August, 2003. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Syria and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Hiroyuki SHIRAIWA
Project Manager,
Basic Design Study Team on
The Project for the Development of
Hydrological and Meteorological
Observation Network
Pacific Consultants International

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Abbreviations

B/C	Basin Center
C/P	Counterpart
EOJ	Embassy of Japan
F/S	Feasibility Study
GPS	Global Positioning System
GDBAB	General Directorate of Barada-Awaj Basin
GDCB	General Directorate of Coastal Basin
JICA	Japan International Cooperation Agency
MC	Main Center
M/D	Minutes of Discussions
MOAAR	Ministry of Agriculture and Agrarian Reform
MOD	Ministry of Defense
MOI	Ministry of Irrigation
M/P	Master Plan
PTTC	Project-type Technical Cooperation
R/D	Record of Discussions
SP	Syrian Pound
SPC	State Planning Commission
UNDP	United Nations Development Plan
WB	Water Resources Information Center
WMO	World Meteorology Organization
WRIC	Water Resources Information Center

EXCHANGE RATE

1 US$ = 121.80 Yen
1 US$ = 51.61 SP
1 SP = 2.360 Yen

SUMMARY

Summary

Syria Arab Republic (hereinafter referred to as "Syria") has an area of 185,180 km^2. In the Coastal Basin, the wind from the west brings about an average annual precipitation of 1,200 to 1,400 mm in the areas around mountain ridges. However, most of other part of the territory has small rain with an annual precipitation less than 250 mm, which results poor water resources condition.

Population of Syria has been increasing rapidly having a high annual rate of 2.7 % and reached 16.92 million in 2002. Population of Damascus including the rural area in the Barada-Awaj Basin (BAB) was 3.84 million and Latakia and Tartus in the Coastal Basin (CB) was 0.87 and 0.67 million respectively in 2002.

In order to cope with the increase in water demand due to industrial development and population increase, the Government of Syria has implemented water resources development and water resources management since 1960. Affected by frequent droughts in the recent years, inadequate water resources management, over abstraction of groundwater, increase in population, etc, draw down of groundwater level and water pollution problems have been taken place, which would become worse in the future.

To solve these issues of water resources, the Government of Syria requested the Government of Japan to formulate a master plan for comprehensive water resources development aimed at five basins (Barada-Awaj, Orontes, Coastal, Aleppo, and Steppe basins) in Syria. In response to the request, Japan International Cooperation Agency (JICA) conducted the Development Study, "Study on Water Resources Development in the Northwest and Central Basins in the Syrian Arab Republic (Phase I and II)", from 1996 to 2000, and recommended establishing a water resources management system in Barada-Awaj Basin. Furthermore, to utilize existing water resources effectively, more detailed and accurate database must be developed, and it is necessary to collect and analyze the data in Coastal Basin where high potential was estimated as water resources.

Based on these recommendations, Project-Type Technical Cooperation (PTTC), "Japanese Technical Cooperation for Establishment of Water Resources Information Center for Improving Water Resources Planning and Management", under the technical assistance of the Japanese Government, for the suitable management of water resources in the Barada-Awaj Basin and the Coastal Basin, has been conducting since June 2002.

Syria already has existing Water Resources Information Center (WRIC); however, WRIC has neither enough data nor capacity to analyze them. In order to reinforce the existing WRIC, the Government of Syria requested the Government of Japan to conduct the "Basic

Design Study on the Project for the Development of Hydrological and Meteorological Observation Network for the Barada-Awaj Basin and the Coastal Basin" (hereinafter referred to as "the Study"). In response to the request, the Government of Japan entrusted the Study to JICA. JICA sent a Basic Design Study Team (hereinafter referred to as "the Team") to Syria, and the Team conducted a field survey in Syria from February 24 to March 21, 2003. Following the field survey, the Team carried out further work and prepared a draft basic design report in Japan. Subsequently, the Team explained and discussed with the Government of Syria about the draft report in Syria from June 22 to July 3, 2003.

In the field survey carried out from February to March 2003, contents of the requested equipment and materials are confirmed and reviewed based on the previous JICA studies from1996 to 2000 and the progress of ongoing PTTC started from June 2002. The Team held a series of discussions with the responsible persons of Ministry of Irrigation and conducted field survey in the study area. In the course of the discussions and field survey, both parties confirmed main policies of basic design as described below:

1) Equipment already or to be provided by PTTC Project are deleted.
2) Meteorological stations, which can be covered by the existing ones, are deleted.
3) Equipment for research and study, not for the monitoring of water resources, is deleted.
4) The M/P and F/S of water resources development have been done for the Barada-Awaj Basin, therefore, locations and contents of the meteorological stations were planned by reviewing them.
5) For the Coastal Basin, F/S has not been done, therefore, plan was made based on the Guide of WMO and a Japanese standard in principle and taking account of topography and meteorology.

Also both Syrian and Japanese parties confirmed that Japanese side will supply equipment and materials for hydrological and meteorological observation, and that Syrian side should be responsible for land acquisition and grading for installation of the equipment.

As the result of the Study, outline of the Project is tabulated as follows.

Procurement of Equipment and Materials

No	Name of Equipment	Main Specifications or Components
1	**Meteorological Observation**	Automatic weather station system (21 sets), Snow observation equipment (22 sets), Auto recording rainfall system (24 sets), Automatic evaporation observation system (6 sets)
2	**Surface Water Observation**	Portable auto water current meter (9 units), Auto water level measuring system (53 sets), Water quality analysis device (9 sets)
3	**Groundwater Observation**	Portable water level detector (9 units), Auto groundwater measuring system (144 sets), Auto water quality measuring system (46 sets)
4	**Related Equipment**	Water sampler (9 units), Well logging equipment (1 unit), Vehicle (5 units), PC (18 units)

A total of 14.5 months will be required for implementation of the Project including detailed design stage (5 months) and procurement stage (9.5 months). Also, for implementation of the Project, the budget to be borne by the Japan's Grant Aid is estimated at 607 million yen, and the budget to be borne by the Government of Syria is estimated at 28 million SP (1 US$ = ¥ 121.80, 1 US$ = 51.61 SP, 1 SP = ¥ 2.360).

The following effects and improvements are expectable with implementation of the Project.

1) It enables understanding of regional and seasonal distribution of the precipitation, temperature, humidity, evaporation etc. in each basin.
2) It enables acquisition of regional water resources information fluctuating with time.
3) It enables understanding of groundwater characteristic such as groundwater flow and contamination.
4) It enables some examinations necessary for water resources management.

In order to implement the Project effectively and sustain its effects, Syria side shall execute the following matters.

1) Items to be undertaken by Syria side such as riverbed fairing, site preparation, installation of fence, etc. shall be executed.
2) The staff and organizations required for meteorological and hydrological observation shall be prepared and established. Moreover, annual budget required for operation and maintenance expenses is secured every year for smooth implementation of the observation system.

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CHAPTER 1 BACKGROUND OF THE PROJECT

Syria Arab Republic (hereinafter referred to as "Syria") has an area of 185,180 km^2. In the Coastal Basin, the wind from the west brings about annual precipitation of 1,200 to 1,400 mm in the areas around mountain ridges in winter. However, most of other part of the territory has small rain with an annual precipitation of less than 250 mm, which results poor water resources condition.

Population of Syria has been increasing rapidly having a high annual rate of 2.7 % and reached 16.92 million in 2002. Population of Damascus including the rural area in the Barada-Awaj Basin (BAB) was 3.84 million and Latakia and Tartus in the Coastal Basin (CB) was 0.87 and 0.67 million respectively in 2002.

In order to cope with the increase in water demand due to industrial development and population increase, Syria has implemented water resources development and water resources management since 1960. Affected by frequent droughts in the recent years, inadequate water resources management, over abstraction of the groundwater, increase in population, etc, draw down of groundwater level and water pollution problems have been taken place, which would become worse in the future.

In order to use the water resources effectively, more detailed and accurate database must be developed, and the Government of Syria requested the Government of Japan to conduct a Basic Design Study on the Project for the Development of Hydrological and Meteorological Observation Network for the Barada-Awaj Basin and the Coastal Basin (the Study). In response to the request, the Government of Japan decided to conduct the Study and entrusted the Study to Japan International Cooperation Agency (JICA). JICA sent a Basic Design Study Team (the Team) to Syria, and the Team conducted a field survey in Syria from February 24 to March 21 2003, and explained and discussed the Draft Report from June 22 to July 3, 2003.

CHAPTER 2
CONTENTS OF THE PROJECT

CHAPTER 2 CONTENTS OF THE PROJECT

2-1 Basic Concept of the Project

2-1-1 Targets and Objectives of the Project

Syria has already existing Water Resources Information Center (WRIC) who has neither enough data nor capacity to analyze them. In order to reinforce the existing WRIC, Project-type Technical Cooperation (PTTC) under the technical assistance of the Japanese Government, for the suitable management of the water resources in the Barada-Awaj Basin and the Coastal Basin, has been conducting since June 2002. It is expected that through the execution of this Project and using the technology transferred by the PTTC, water resources in the whole basin will be managed properly.

Target of the Project is as follows:

Overall Goal

To achieve integrated and sustainable water resources management in the Barada-Awaj and the Coastal basins

Project Purpose

To establish a system collecting and processing the data on meteorological and hydrological information in order to formulate a adequate framework for water resources management in the Barada-Awaj and the Coastal basins

2-1-2 Outline of the Project

In order to achieve the above goal, the Water Resources Information Center (WRIC) in the General Directorates of the Barada-Awaj Basin (GDBAB) and the Coastal Basin (GDCB), Ministry of Irrigation (MOI) will manage the water resources information. The WRIC Main Center will collect the data on meteorology, surface water and groundwater within BAB (about 8,500 km^2) and CB (about 5,000 km^2) through WRICs of GDBAB and GDCB, and establish an information system by combining other date related to water resources management such as water use, population, industry, etc.

Thus it is expected that the effective and accurate data collection, data processing and data transmission system will be established. This Project aims the development of data collection and processing system and procurement of equipment and materials

related to meteorology and hydrology. For proper water resources management, seasonal and regional distribution of water resources as well as their uses in terms of their purposes are required information. The data on precipitation, as "IN," and the data on surface water discharge, groundwater level and water use volume data, as "OUT", are the most important data. These data could be used for studies of water use plan, water resources development plan, water saving method, countermeasures against drought, regional development method, etc.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Basic policy

Based on the previous JICA studies from1996 to 2000 and the progress of ongoing "Japanese Technical Cooperation for Establishment of Water Resources Information Center for Improving Water Resources Planning and Management (PTTC) " started from June 2002, contents of the requested equipment and materials are confirmed and reviewed. The Basic Design Study Team (The Team) held a series of discussions with the responsible persons of MOI and conducted field survey in the study area. In the course of the discussions and field survey, both parties confirmed the main items as described in the Minutes of Discussions (M/D) dated February 27, 2003. The Team has preceded further work and prepared the Draft Report. Major policies of the basic design are as follows:

1) Equipment already or to be provided by PTTC Project are deleted.

2) Meteorological stations, which can be covered by the existing ones, are deleted. Inventory surveys made by the PTTC team were used for avoiding duplication.

3) Equipment for research and study, not for the monitoring of water resources, is deleted.

4) The M/P and F/S of water resources development have been done for the Barada-Awaj Basin, therefore, locations and contents of the meteorological stations were planned by reviewing them.

5) For the Coastal Basin, F/S has not been done, therefore, plan was made considering the Guide of WMO and the Japanese standard taking account of topography and meteorology.

(2) Scope of Japanese Assistance

In this Project, Japanese side will provide the minimum equipment/ materials and related ones required for the collection of meteorological and hydrological data. Syrian side will acquire the lands required for installation of the equipment and grading of the lands and fences. In relation to the automatic surface water level stations, required fairings of riverbeds to be undertaken by Syrian side are decided taking account of the budget of GDBAB and GDCB.

(3) Equipment for meteorological observation

1) Based on the proposed sites of the meteorological stations and discussions with Syrian side, locations of the equipment were proposed. Major items discussed were availability of existing equipment, topography, wind direction, etc. During the 2nd survey in Syria, locations of the equipment proposed by Syrian side were confirmed, and designed in Japan.

2) One AWS shall have a land space of 15m x 15m or more、and 10m x 10 m or more for precipitation station. Concrete sites of the stations are to be decided taking access, ease of land acquisition, requirements for observation, etc into account.

3) Meteorological stations are proposed at representative locations considering the wind from the Mediterranean Sea, altitude and topography.

4) One precipitation station per basin area of 100 to 250 km^2 for WMO and 100 km^2 for the Japanese standard in mountainous area. Taking the existing stations into account, one station per approximately 100 km^2 was applied.

5) Evaporation stations are proposed near the existing reservoirs for the estimation of lake evaporation.

6) Air pressure in AWS is deleted because of less importance for water resources management.

(4) Equipment for surface water observation

1) Automatic water level stations are planned to provide at major points where discharge change due to inflow or intake and at the major springs. Water level and discharge data of the existing dams in GDCB will be used.

2) In order to get the time series of river discharge, periodic discharge measurements are required. If it is difficult get accurate discharge at some locations of the water level stations, fairing of riverbed are considered through discussions with WRIC. However, number of sites of the fairing works will be minimized.

3) Ultrasonic water meter is deleted because it is applicable to mainly rectangular waterway and not for natural channel.

4) In the 2nd Study in Syria, concrete locations of the equipment planned by Syrian Side were discussed and confirmed at the sites. Further basic design study was made in Japan based on the results of discussions.

(5) Equipment for groundwater observation

1) Automatic water level and water quality observation will be made for monitoring of their variation in wide areas. The observations, together with the data from the proposed well logging equipment, will be useful to know general hydro-geologic characteristics in wide areas.

2) Automatic groundwater level and water quality stations are proposed in the areas with potential problems such as areas of water sources, areas using groundwater extensively and areas affected by pollution including salinity.

3) In the Barada-Awaj Basin, proposed water level and water quality stations are densely distributed in Damascus and its surrounding areas. Considering the effects of water level lowering by groundwater abstraction, intervals of the water level stations are proposed 2 - 5 km in the mountainous and Damascus areas, about 5km in the flat area around Damascus and 10 km interval in other areas.

4) In the Coastal Basin, proposed water level and water quality stations are densely distributed in the areas around Latakia, Tartus and the water source areas near the center of coastal strip. For these areas, 5 - 10 km intervals are proposed. In other areas, 10 - 20 km intervals are proposed.

5) Based on the above conditions, automatic water level and water quality observation are proposed. In the M/D on the Draft Report, 106 wells were proposed, however, 8 wells located outside the Study Area and with the cable length more than 300 m (because of trouble due to its extension) were deleted.

The following numbers of the existing monitoring wells were selected.

Observation Item	GDBAB	GDCB	Total
Groundwater level	77	21	98
Groundwater Level/Quality	33	13	46

6) The wells to be used for automatic observation shall have protection of data logger by concrete or steel box.

(6) Related equipment

1) As described in the M/D, all equipment except Water Sampler, Well Logging Equipment and Field Vehicles were deleted. Geo-electric Device and Refraction Seismic Device are not for monitoring but rather research. GPS and Field Photometer has been or to be provided by the ongoing WRIC Project (PTTC).

2) As to the well logging equipment, most of the existing wells don't have geological information. In order to know the origin of ground water, this equipment is effective. GDBAB has one unit of well logging equipment having a monitoring depth of 1,500 m, however, it has been used for about 20 years and difficult to use for a long time. In the M/D on the Draft Report, measuring depth more than 1,500 m was proposed. Considering that the maximum depth of the existing monitoring wells is 815 m and mostly less than 300 m, it is revised to be 300 m.

3) Field vehicles are to be used for collection of data from the new stations, their inspection and hydrological measurements. Presently, WRICs are using old vehicles supplied during the time of Soviet Union, and require once a month inspection and repairing, therefore, they will be difficult to use for a long time. The vehicles provided by the ongoing WRIC Project can be used for the fieldwork. However, additional vehicles will be required taking a large volume of additional fieldwork, effects of snowfall, etc into account.

(7) Soft component

Soft component is not applied for this project and, instead, training of WRIC staff for operation and maintenance by the contractor during installation of the equipment is planned.

(8) Related Projects

During the beginning of 1990s, Russian Government and others had provided hydrological equipment, and some of them are still functioning. However, there is no

plan to provide such equipment. MOI had a study "Dr. Peter Papanov: Hydrological Observations in Syria, Review, January 2001," and pointed out that the JICA F/S plan is a problem with duplication with the existing stations. This plan reviewed the present stations based on the inventory survey made by PTTC.

(9) Policy regarding natural conditions

1) The Coastal Basin is affected by the west wind from the Mediterranean Sea. On the top of mountains, average annual precipitation reaches from 1,400 mm to 1,200 mm and with snow, while in the flat area near the coast has about 800 mm. In the Barada-Awaj Basin, the mountains interrupt the west wind resulting smaller average annual precipitation than that of Coastal Basin from 600 mm with snow in the high areas and 200 mm in the low and flat areas. Locations of the meteorological stations have been proposed considering these conditions.

2) All rivers are of steep slope except lower part of the Barada and Awaj rivers with large flow velocity. Automatic water level stations shall be located where it is easy to measure the flow area and velocity.

3) Rainy season in the Study Area is roughly October to April and the rest is dry season. River flows exist even after 1 - 2 months after the end of rainy season, which depend on the river and spring. These conditions are taken into account in the schedule of the proposed works affected by river flow.

(10) Policy regarding social conditions

1) Proposed meteorological and hydrological stations are scattered in a vast areas. For the convenience of operation and maintenance work, locations with good access should be selected as much as possible.

2) The stations, which will require a frequent management, namely snowfall/snow depth and evaporation, should be located near the villages or existing offices of the dams.

3) Existing surface water level stations are not effective to obtain the river discharge data. In order to get the time series of the discharge, combination of the automatic water level station and the river discharge measurement shall be done. Riverbed fairing in some automatic water level stations as carried out in Syria are required.

4) Construction works are generally executed by contracting with local contractors; however, the General Directorates can directly do small-scaled civil works. Each General Directorate has a design section with the basic knowledge, however it will be difficult to manage a project with many stations. The works in the rivers are done when there is no river flow, and should be considered in the basic design.

5) GDs execute construction works, however, operation of the equipment will require training in the stage of installation. For the operation and maintenance, field vehicles will be required due to increase in the numbers of meteorological and surface water stations.

(11) Policy on construction method and procurement

1) In Syria, agents of the makers from European Union nations exist; therefore, procurement from the third country is also considered.

2) Installation works of the proposed meteorological and groundwater equipment are possible in the rainy season, however, the river-bed fairing, in relation to the surface water level stations, are scheduled to carry out in the dry season. Syrian side has a program to conduct the works and partially by the 2003 budgets. In 2003, river flow is still large in July, therefore, GDBAB is waiting for the construction works until the flows go down. Considering the above conditions, installation of the surface water level stations is planned that a part of the riverbed fairing works are possibly done later.

2-2-2 Basic Plan (Equipment Plan)

(1) Comparison of the Request and Basic Design

The equipment and materials requested by the Syrian Government are as follows:

a. Equipment for Meteorological Observation
b. Equipment for Surface Water Observation
c. Equipment for Groundwater Observation
d. Related Equipment
e. Office Equipment
f. Soft Component

The contents of the request were reviewed and the general specification and quantities of the equipment were examined in the Basic Design Study based on the results of the surveys in Syria and “2.1 Policy of Planning”. For the examination of the equipment,

the equipment, which has been already prepared or to be provided by the on-going PTTC is deleted.

For the equipment of the automatic meteorological observation system, rain gauge, auto water level recorder (surface water), groundwater level recorder and groundwater level and quality recorder, two sets of the spare parts of sensors and data loggers are proposed for the purpose of the observation during the repair of the equipment. For evaporation, one set is proposed considering small number of equipment.

Table 2-1 (1) Comparison between the Request and the Basic Design

No	Items	Request		M/D & Discussions No	Basic Design				
		Specifications and etc.	No		Reasons	Q'ty (Quantity)			
						GD BAB	GDCB	MC	Total
I	**Equipment for Meteorological Observation**								
1	Automatic weather station (Automatic weather observation system)	Wind direction & speed sensor	20	21	1. Quantities were evaluated considering the actual conditions of the existing stations.	13	7	1	21
		Relative humidity and air temperature meter	20	21	2. The stations proposed by JICA F/S were reviewed in the course of the examination of the equipment.	14	7	0	21
		Global solar radiation sensor	20	21	3. Duplication of the stations with those of other organization was taken into account.	14	7	0	21
		Evaporation gauge	20	21	4. One weather station was planned to be set in BAB for the staff training	0	0	0	0
		Air pressure meter	20	21	5. Snow gauge was excluded in this automatic system because of the difficulty in electricity supply to the stations. Instead, the amount of snowfall is to be measured with snow sampler and weight balance (see No.5).	0	0	0	0
		Sunshine duration sensor	20	21		14	7	0	21
		Rain/snow gauge	20	21		0	0	0	0
		Manual rain gauge	0	0	6. Evaporation is excluded in this system and was planned to be set at the main dam sites in GBCB (see No.3)	14	7	0	21
		Data loggers and others	20	21	7. Air pressure meter is excluded because of less importance for water resources management	14	7	0	21
		Logger box	20	21		14	7	0	21
		Pole, arm & others	20	21		14	7	0	21
		Solar panel, battery & others	20	21		14	7	0	21
2	Rain gauge (Automatic precipitation observation system)	Automatic rain gauge	0	9	Automatic rain gauge is planned to set every 100km^2. Automatic rain/snow gauge was excluded (see "5" above). Snowfall is measured by manual with snow sampler and weight balance shown in No.5.	14	10	0	24
		Automatic rain/snow gauge	60	15		0	0	0	0
		Manual rain gauge	60	0	Manual rain gauge was excluded because automatic rain gauge would cover its performance	0	0	0	0
3	Recording evaporation gauge (Automatic evaporation observation system)	Standard pan (Class A pan)	80	5	The automatic evaporation gauges are planned near six existing reservoirs in GDCB for estimation of evaporation from the reservoirs. Small sized pan to be used for the comparison with standard pan is excluded.	0	6	0	6
		Small sized pan		6		0	0	0	0
4	Digital wind direction & speed sensor (additional)	Sensor and logger	6	0	Additional sensors are excluded because the automatic weather stations could act for their performances	0	0	0	0
5.	Snow gauge and snow sampler	Snow scale, Sampler & weight balance	0	0	Newly introduced for measurement of snowfall	15	7	0	22
II	**Equipment for Surface Water Observation**								
6	Auto current meter (potable)	For river flow measurement	12	12	To be equipped for all hydrological observation teams of GDBAB & GDCB	4	0	1	5
7	Ultrasonic water meter (current meter)	Ultrasonic type	4	1	Ultrasonic water meter is excluded because the auto current meter and auto water level recorder could act for its performance	0	0	0	0
8	Mobile measuring devices, cable-suspended current meter	Portable type	1	1	For large flow measurement of main rivers in GDCB	0	4	0	4

Table 2-1 (2) Comparison between the Request and the Basic Design

No	Items	Request		M/D & Discussions No	Basic Design				
		Specifications and etc.	No		Reasons	Q'ty (Quantity)			
						GD BAB	GDCB	MC	Total
9	Portable water level meter	Manual type, 20m	10	10	Excluded because it is not suitable for surface water	0	0	0	0
10	Auto water level recorder	For river、10m	70	57	Exact locations will be decide by reviewing the site conditions of the existing stations and plan by JICA F/S	33	19	0	52
		For reservoir, 20m		1	To be equipped at a reservoir in GDBAB	1	0	0	1
11	Multi-parameter water quality meter, portable	EC, Ph, DO meter	5	9	To be equipped for all hydrological & groundwater observation teams of GDBAB & GDCB	4	4	1	9
III	**Equipment for Groundwater Observation**								
12	Portable water level meter (for groundwater)	Level+ Temp, 100m	15	13	Excluded because equipment of 300m could act for the equipment of 100m	0	0	0	0
		Level+ Temp, 200m	20	8	Excluded because equipment of 300m could act for the equipment of 200m	0	0	0	0
		Level+ Temp, 300m	20	7	Same as the equipment of 100m	4	4	1	9
13	Data logger (Automatic groundwater level recorder)	Groundwater level and groundwater quality (DO, Ph, EC)	100	79	Temperature was excluded. Cable length set 20m below water level.	(77) +	(21) +		98 +
				19	Stations located outside BAB were excluded.	(33)	(13)	0	46
				4	Cable length more than 300m was excluded because of possible trouble due to expansion.	=	=		=
				4	Reviewed depending on the conditions of existing wells	110	34		144
14	Data logger with cable (Automatic groundwater level and water quality recorder)	Level + quality Depth: 100m	20	41	Quantity and location were examined according to the actual conditions of the monitoring wells Water level is counted in Item 13. Cable length set 20m below water level.	33	13	0	46
		Level + quality Depth: 200m	20	5					
		Level + quality Depth: 300m	20	0					
IV	Related Equipment								
15	Water sampler	Depth: 100m	8	12	To be equipped for all groundwater observation teams of GDBAB & GDCB	4	4	1	9
16	GPS	Portable type	16	0	To be excluded because GPS will be provided by WRIC Project	0	0	0	0
17	Well logging equipment	Depth: 200m	1	1	It is necessary for acquisition of important data for WRIC, logging depth 300m according to the actual depth of the observation wells	1	0	0	1
18	Geo-electrical device (Electric sounding device)	AB=2,000m	2	0	Excluded because it is used for purposes of study	0	0	0	0
19	Refraction seismic device (Seismic exploration device)	Refraction method	2	0	Same as above	0	0	0	0
20	Field photometer	Water quality analysis device of photometer type	5	0	Excluded because photometer will be provided by WRIC Project	0	0	0	0
21	Field Vehicle	4WD type	5	5	Additional four 4WD vehicles would be needed according to increase in field work using the equipment to be prepared by this project One pick-up type is required to replace existing old car in GDBAB	3	2	0	5
22	Digital camera	For field survey	8	0	Excluded because some digital cameras would be provided by WRIC Project	0	0	0	0
23	Personal computer	Note type	8	0	Same as above	0	0	0	0
V	Office Equipment								
24	Personal computer	Desk-top type	20	0	It was excluded because it had been already provided by WRIC Project	0	0	0	0
25	Scanner	A0 size	2	0	Same as above	0	0	0	0
26	Plotter	A0 size	2	0	Same as above	0	0	0	0
27	Digitizer	A0 size	2	0	Same as above	0	0	0	0
28	Colored laser printer	A3 size	2	0	Same as above	0	0	0	0
29	Laser printer	A3 size	5	0	Same as above	0	0	0	0
30	Soft wares	Analysis for surface water, groundwater and meteorology	1 set	0	Excluded because necessary soft wares will be provided by WRIC Project	0	0	0	0
VI	Staff Training								
31	Soft component	Training of operation and maintenance of equipment	Lump sum	Lump sum	Excluded. Training is planned to carry out by the contractor during installation work.	0	0	0	0

M/D: Minutes of Discussion, GDBAB: General Directorate of Barada-Awaj Basin, GDCB: General Directorate of Coastal Basin, MC: Main Center

(2) Basic Plan

The equipment and materials to be provided by this Project will be used to collect the data for WRIC Main Center through GDBAB and GDCB. The ongoing Project-type Technical Cooperation Project (PTTC) is studying the basic plan including data processing; therefore, this basic design studies mainly the quantities and main specifications of the equipment.

Expected effects of the project are to obtain more accurate meteorological and hydrological data and to use for studies, planning and management related to the water resources such as water resources potential, planning of dam, regulation of groundwater abstraction, distribution of water, saving of irrigation water, countermeasures against drought, re-use of wastewater, dispersion of population, land use plan, etc. The data obtained by this Project will be an important base.

1) Equipment for meteorological observation

Installation plans of the meteorological observation equipment are shown in Figure 2-1 (1) (Barada-Awaj Basin) and Figure 2-1 (2) (Coastal Basin). The items and general specifications of the equipment are as follows:

- Automatic weather station (21 sets)
    - Wind direction and speed..... Vane type direction sensor and cup type speed sensor
    - Relative humidity and air temperature meter Electric humidity meter and electric temperature meter
    - Global solar radiation..... Electric all-weather type sensor
    - Sunshine duration sensor ..... Solar battery type sensor
    - Rain gauge..... Tilting bucket type gauge without heating devices for snowfall measurement
    - Sensors and data loggers of the five devices listed above with two sets of spare parts
    - Accessories such as pole, arm, solar panel, battery and others
- Rain gauge (24 sets)
    - Rain gauge..... Tilting bucket type gauge without heating devices for snow fall measurement with two sets of the spare parts
    - Accessories such as pole, arm, solar panel, battery and others

- Recording evaporation gauge (6 sets)

    - Evaporation gauge..... Evaporation pan type gauge, class A pan
    - Sensor and data logger attached to the gauge with one set of the spare parts
    - Accessories such as pole, solar panel, battery and others

- Snow gauge and snow sampler (22 sets)

    - Snow scale..... Stationary type
    - Snow sampler..... Tube type sampler
    - Weight scale..... Digital type platform scale

For the AWS system, rain gauge is used. Because of the difficulty in obtaining electricity for the heater used for melting the snow, snowfall measurement is planned to do by manual using snow sampler and weight balance.

An automatic weather station needs a flat area of 15m by 15m without obstruction to which the access is easy. For the rainfall station and the evaporation station, an area of 10m by 10m that has the same conditions as the automatic weather station is needed. General locations of the stations were planned in this study, and Syrian side will select exact locations by June 2003 taking account of accessibility and ease of land acquisition. In the 2nd survey in Syria, some stations, which seem problem, were confirmed at each site.

For the Barada-Awaj Basin, the locations and the number of meteorological stations were reviewed based on the recommendation by JICA F/S, avoiding the duplication with existing weather stations being operated by the Department of Meteorology and Ministry of Agriculture in BAB. The existing stations, which are being well operated and reliable according to the inventory survey conducted by WRIC, are taken into account. Consequently, new 14 automatic weather stations and 14 rainfall stations are planned in Barada-Awaj Basin as shown in Figure 2-1 (1).

Since F/S has not been done for the Coastal Basin, contents of the request from Syrian side were examined through the field reconnaissance and discussions with Syrian side. Locations and the numbers of the meteorological stations are planned with the same method as that of BAB. Consequently, 7 automatic weather stations, 10 rainfall stations and 6 evaporation stations are planned in Coastal Basin as shown in Figure 2-1 (2).

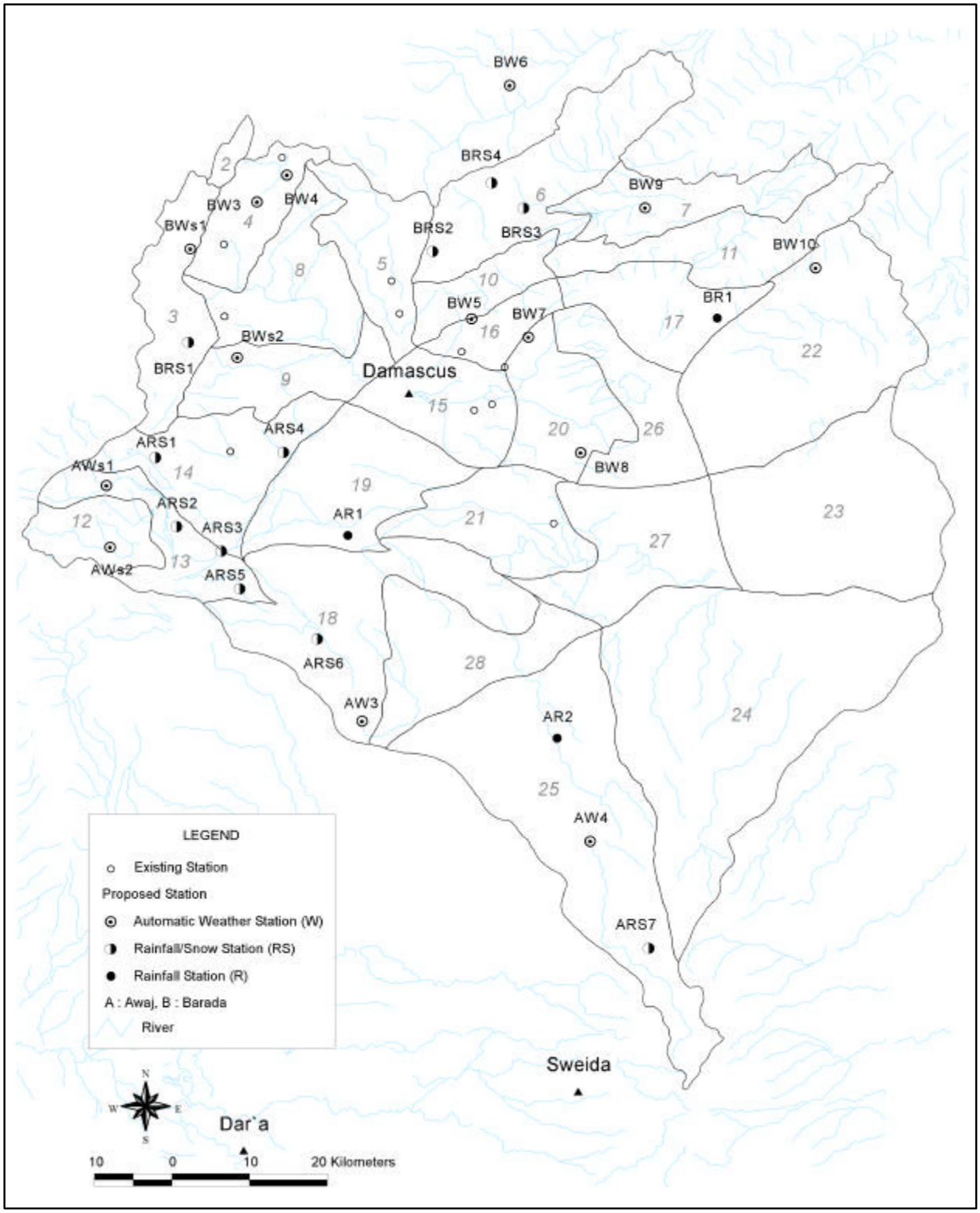


Figure 2-1 (1) Location Map of Meteorological Stations (Barada-Awaj Basin)

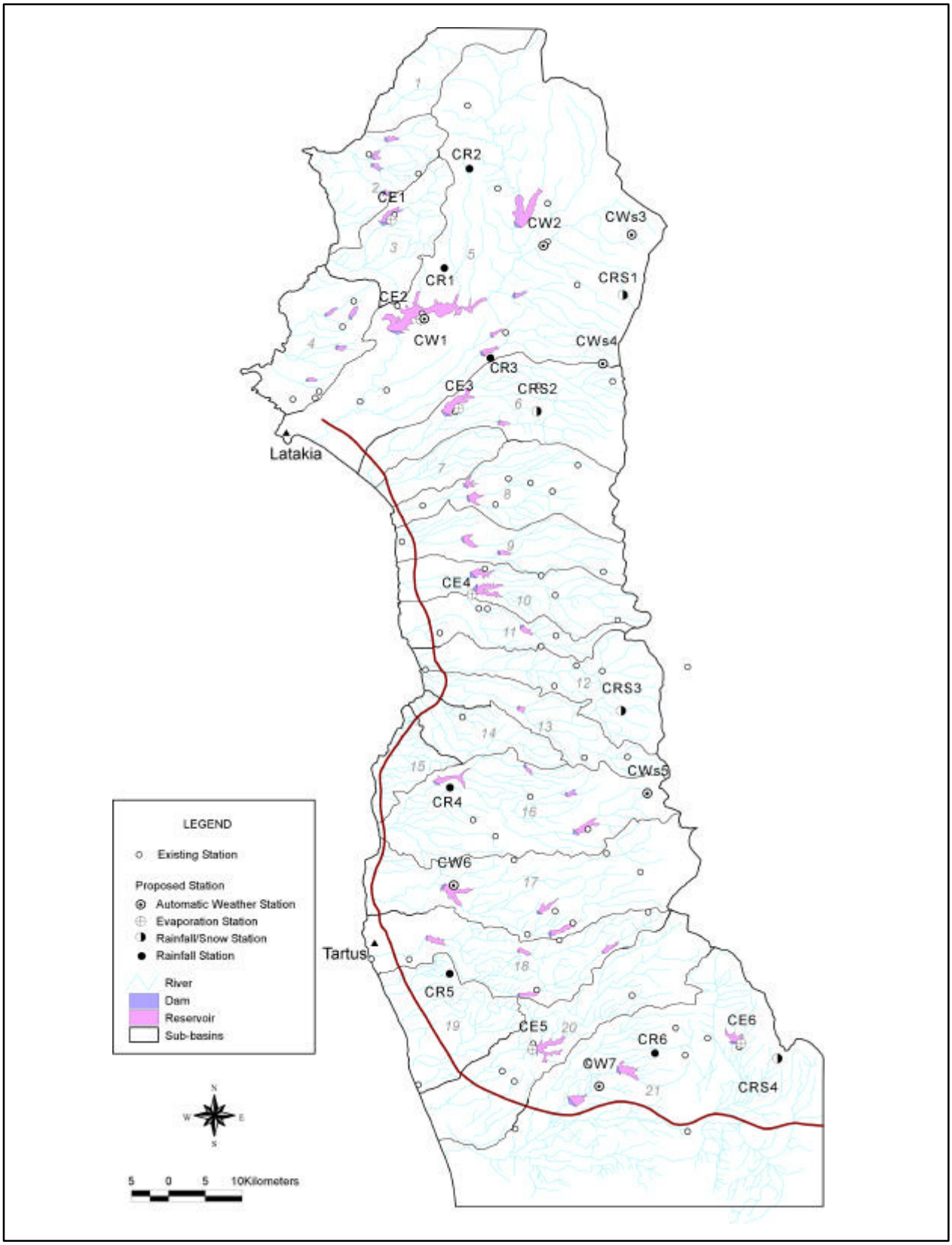


Figure 2-1 (2) Location Map of Proposed Meteorological Stations (Coastal Basin)

Table 2-2 Installation Plan of Meteorological Stations

Barada-Awaj Basin

Station No		Longitude/Latitude		AWS	Snowfall	Rainfall	Evapo.
B/D	Ledger	X	Y				
Barada River Basin							
BWs1	108	35°59'22"	33°39'50"	○	○		
BWs2	110	36° 3'29"	33°32'12"	○	○		
BW3	93	36° 5'35"	33°44' 3"	○			
BW4	107	36° 6'56"	33°47'28"	○			
BW5	112	36°25'17"	33°36' 7"	○			
BW6	88	33°50'10"	36°26'14"	○			
BW7	98	36°28'31"	33°35' 2"	○			
BW8	99	36°33'38"	33°27'14"	○			
BW9	92	36°38'33"	33°44'12"	○			
BW10	95	36°53'18"	33°39'38"	○			
BRS1	109	36° 0'39"	33°34'31"		○	○	
BRS2	86	36°20'10"	33°40'25"		○	○	
BRS3	89	36°28'3"	33°44'39"		○	○	
BRS4	87	36°23'38"	33°45'29"		○	○	
BR1	94	36°42'26"	33°35'51"			○	
Awaj River Basin							
AWs1	101	35°53'40"	33°22'53"	○	○		
AWs2	113	35° ' "	33° ' "	○	○		
AW3	111	36°16'19"	33° 6'43"	○			
AW4	97	36°35' 9"	32°59'16"	○			
ARS1	100	35°57'51"	33°25' 9"		○	○	
ARS2	103	35°59'56"	33°21'23"		○	○	
ARS3	102	36° 3'25"	33°18'51"		○	○	
ARS4	91	36° 9'11"	33°25'38"		○	○	
ARS5	104	36°6'20"	33°15'60"		○	○	
ARS6	105	36°12'7"	33°14' 4"		○	○	
ARS7	96	36°38'24"	32°53'53"		○	○	
AR1	106	36°15'52"	33°19'35"			○	
AR2	90	36°30'56"	33° 6' 5"			○	
Sub-Total				14	15	14	0

Coastal Basin

Station No		Longitude/Latitude		AWS	Snowfall	Rainfall	Evapo.
B/D	Lodger	X	Y				
Latakia							
CW1	9	36°55' 3"	35°38'21"	○			
CW2	2	36° 6'25"	35°44'31"	○			
CWs3	1	36°10'16"	35°44'41"	○	○		
CWs4	5	36°10' 5"	35°36'26"	○	○		
CRS1	6	36° 9'32"	35°40'15"		○	○	
CRS2	4	36° 5'18"	35°33'56"		○	○	
CR1	7	36°58'44"	35°41'24"			○	
CR2	8	36° 1'12"	35°49'50"			○	
CR3	3	36° 1'44"	35°36'26"			○	
CE1 (Balloran)	10	35° 54'4.0"	35°45'53.4"				○
CE2 (Teshreen)	13	35°55'2.9"	35°38'21.4"				○
CE3 (Althaw)	12	35°58'54.1"	35°32'7.0"				○
CE4 (Skabara)	11	36°1'37.6"	35°19'40.1"				○
Tarutus							
CWs5	2	36°15'14"	35° 4'30"	○	○		
CW6	4	35°58'23"	34°57'25"	○			
CW7	10	36° 8'20"	34°42' 4"	○			
CRS3	1	36°12'54"	35°11'20"		○	○	
CRS4	7	36°22'24"	34°44'33"		○	○	
CR3	3	35°55'14"	35° 4'36"			○	
CR4	5	35°59'24"	34°49'39"			○	
CR5	6	36°11'58"	34°43'55"			○	
CE5		° ' "	° ' "				○
CE6		° ' "	° ' "				○
		Sub-Total		7	7	10	6
			Total	21	22	24	6

Notes: AWS: Automatic system with Wind speed/direction, Relative humidity/air temperature, Global soler radiation, Sunshane duration and Rainfall gauges
B : Barada Basin
A : Awaj Basin

2) Equipment for surface water observation

- Potable current meter

  This is used for measuring the velocity in order to get the discharge. Four (4) teams for each of GDBAB and GDCB, one team for Main Center is planned.

  One set for each team, in total 9 sets.

  Velocity measurement point will be upstream side of the water level station, and the location will be selected at the site where riverbed is stable, or fairing of riverbed can be made as required.

- Automatic water level observation system

  Auto water level recorder is the system, which continuously records the river water level that gives river flow rate. The system is mainly composed of water level sensor, cable and data logger with battery.

  The auto water level recorder will be set in the middle to lower reaches of the main rivers in order to get the flow data of these points in addition to the existing reservoirs in the Coastal Basin. The auto water level recorder will be set at the changing points of the flow rate located in the upper reaches of the main rivers in Barada-Awaj Basin. Pressure type of the water level sensor is proposed because its price is relatively low and the installation of the sensor is relatively easy too.

  Number of the stations: Barada-Awaj Basin 34 stations, Coastal Basin 19 stations, 53 stations in total

- Portable water level meter was deleted because it is usually used for the groundwater, and not suitable for the surface water.

- Multi-parameter water quality meter, portable (9 sets)

  The number of the multi-parameter portable water quality meter is proposed 9 sets for the same reason as the manual current meter.

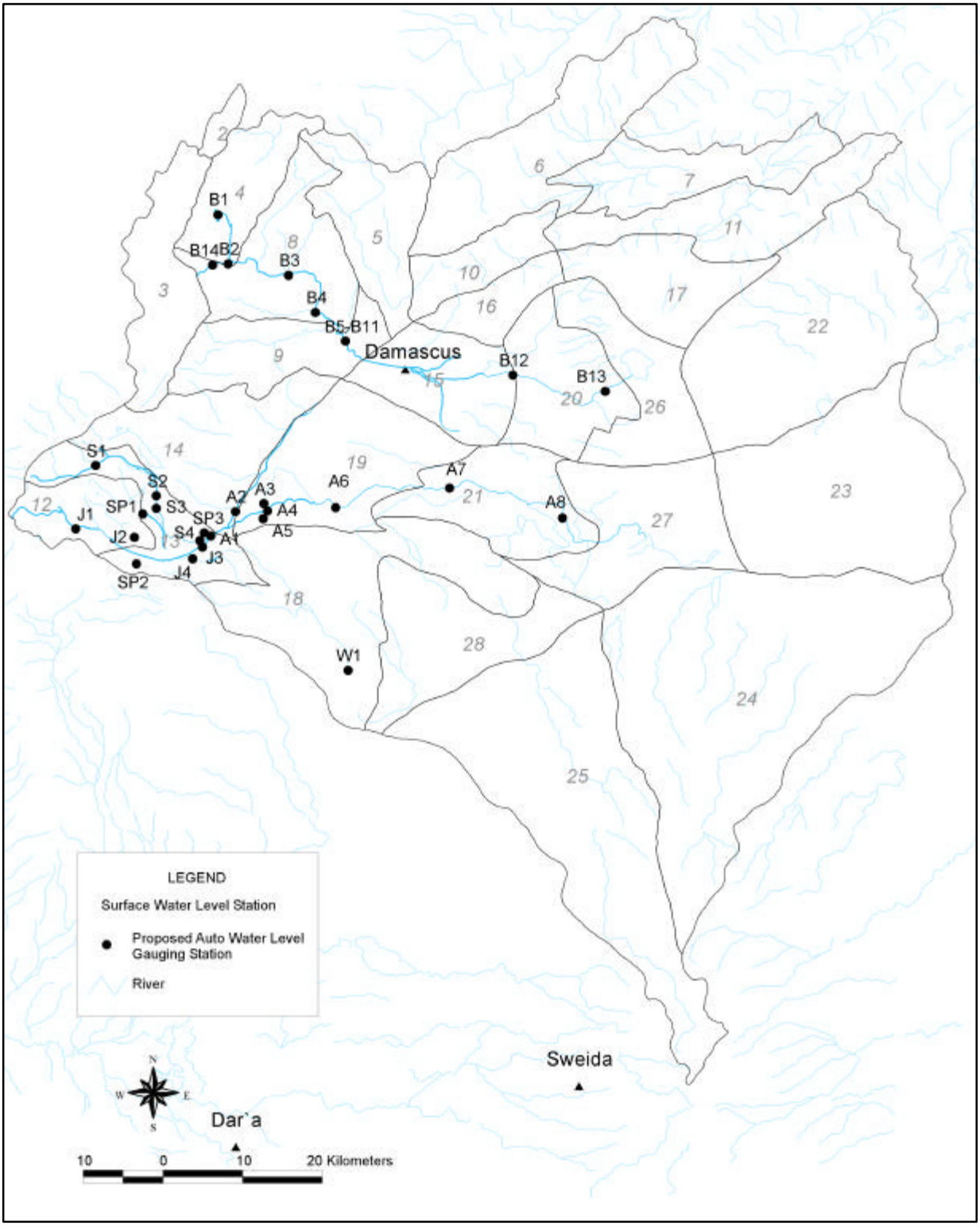


Figure 2-2 (1) Location Map of Proposed Surface Water Level Stations (Barada-Awaj Basin)

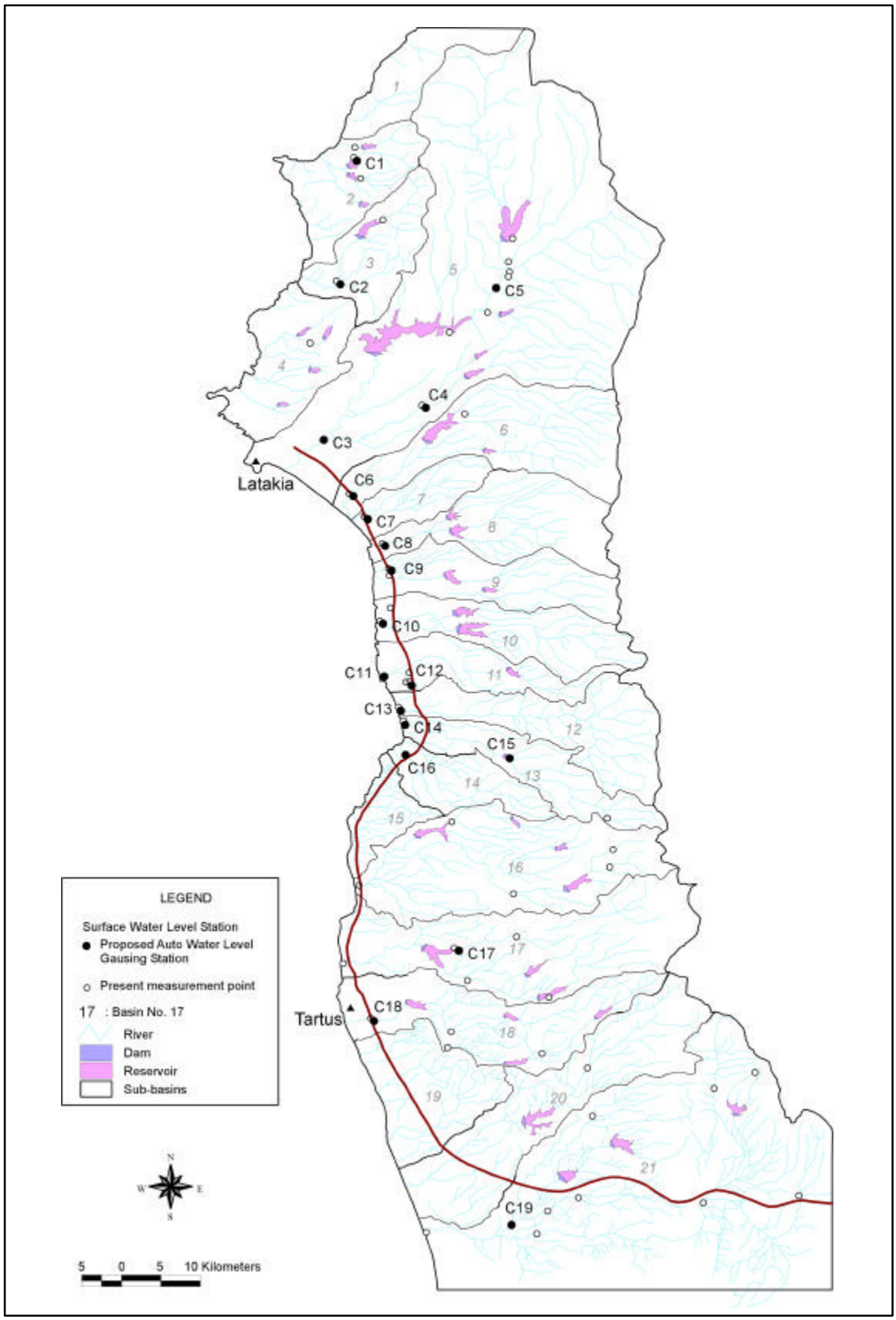


Figure 2-2 (2) Location Map of Proposed Surface Water Level Stations (Coastal Basin)

Table 2-3 Installation Plan of Surface Water Level Stations

1. Barada-Awaj Basin

Station No.		Longitude/Latitude		Name of River, etc.		Name of Station	Faring Bridge. Etc	Remarks	Range of Water Level (m)	Length of Cable (m)	
B/D	Ledger	X	Y	Basin	River, Spring						
B1	13	36° 3’23”	33°43’32”	Barada	Outlet of Spring	Ramleh	Equip. only		3	5 fix	10
B2	15R	36° 4’24”	33°27’21”	Barada	Tributary	Tkehy	Sta. Br. Fa.		2.5	10 cover	10
B3	3R	36°14’21”	33° 8’36”	Barada	Main River	Fijeh	Sta. Br. Fa.		3	5 fix	10
B4	4R	36°12’29”	33°33’58”	Barada	Main River	Hameh	Sta.		4	10 cover	10
B5		° ’ ”	° ’ ”	Barada	Diversion	Yazael	Sta.		3	5 fix	10
B6		° ’ ”	° ’ ”	Barada	Diversion	Tora	Sta.		3	5 fix	10
B7		° ’ ”	° ’ ”	Barada	Main River	Arabweh	Sta. Br. Fa.		3	5 fix	10
B8		° ’ ”	° ’ ”	Barada	Main River	Qanawat	Sta.		2	5 fix	10
B9		° ’ ”	° ’ ”	Barada	Diversion	Deerani	Sta.		2	5 fix	10
B10		° ’ ”	° ’ ”	Barada	Diversion	Mazzawe	Sta.		2	5 fix	10
B11		° ’ ”	° ’ ”	Barada	Diversion	Banyas	Sta.		2.5	5 fix	10
B12	6R	36°29’30”	33°30’ 9”	Barada	Main River	Nashabeh	Sta.		4	5 fix	10
B13	14	36°35’11”	33°28’25”	Barada	Main River	Otaybeh	Sta. Br. Fa.		3	5 fix	10
B14	50D	36° 2’41”	33°37’21”	Barada	Qalen Dam	Dam	Equip. only	Dam	3	50 fix	50
SP1		° ’ ”	° ’ ”	Awaj	Spring	Manbij	Sta.		2	5 fix	10
SP2		° ’ ”	° ’ ”	Awaj	Spring	Tommaseyat	Sta.		2	5 fix	10
SP3		° ’ ”	° ’ ”	Awaj	Spring	Tabibeyh	Sta.		2	6 fix	10
J1		° ’ ”	° ’ ”	Awaj	Jenani	Betjin	Sta. Br. Fa.		2	5 fix	10
J2	23R	35°53’56”	33°18’44”	Awaj	Jenani	Mazraa	Sta. Br. Fa.		2	10 fix	10
J3		° ’ ”	° ’ ”	Awaj	Jenani	Aboqawoq	Sta. Br. Fa.		2	10 cover	10
J4		° ’ ”	° ’ ”	Awaj	J.Diversion	Kanakree	Sta.		2	5 fix	10
S1	24R	35°53’25”	33°22’33”	Awaj	Seebarani	Arneh	Sta.		3	5 fix	10
S2	25R	° ’ ”	° ’ ”	Awaj	Seebarani	Betima	Sta. Br. Fa.		2.5	5 fix	10
S3		° ’ ”	° ’ ”	Awaj	Seebarani	Betsaber	Sta. Br. Fa.		2	10 fix	10
S4		° ’ ”	° ’ ”	Awaj	Seebarani	Aboqawoq	Sta.		2	5 fix	10
A1	113	36° 3’19”	33°18’51”	Awaj	Main River	Om Alshrateet	Sta.		2.5	5 fix	10
A2	46	° ’ ”	° ’ ”	Awaj	M.Diversion	Deerani	Sta.		2.5	5 fix	10
A3	28R	° ’ ”	° ’ ”	Awaj	M.Diversion	Derlkhabani	Sta.		2	5 fix	10
A4	29R	° ’ ”	° ’ ”	Awaj	Main River	Zakyani	Sta.		2	5 fix	10
A5	20R	° ’ ”	° ’ ”	Awaj	M.Diversion	Abaseh	Sta.		2	5 fix	10
A6	21R	° ’ ”	° ’ ”	Awaj	Main River	Maraneh	Sta. Br. Fa.		4	10 fix	10
A7	116	° ’ ”	° ’ ”	Awaj	Main River	Najha	Sta. Br. Fa.		3	15 cover	20
A8	22R	° ’ ”	° ’ ”	Awaj	Main River	Hayjaneh	Sta. Br. Fa.		3	10 fix	10
W1	31R	° ’ ”	° ’ ”	Awaj	Wadi	Alkhanafis	Sta. Br. Fa.		3	10 fix	10

2. Coastal Basin

Station No.		Longitude/Latitude		Name of River, etc.		Name of Station	Faring Bridge. Etc	Remarks	Range of Water Level (m)	Length of Cable (m)	
B/D	Ledger	X	Y	Basin	River,Spring						
C1(CL1)	19	35°53’45”	35°51’ 8”	Latakia	2.Al Shika Hassan		Sta. Br. Fa.	Steep slope	3	10 cover	10
C2(CL2)	17	° ’ ”	° ’ ”	Latakia	3.Wadi Kandil		Sta.	Fa.better	5	10 cover	10
C3(CL3)	29	° ’ ”	° ’ ”	Latakia	5.Al Arab		Sta. Br. Fa.		5	20 cover	20
C4(CL4)	24	35°58’45”	35°34’28”	Latakia	5.Al Arab		Sta. Br. Fa.		5	10 cover	10
C5(CL5)	12	° ’ ”	° ’ ”	Latakia	5.Al Arab		Sta.		7	20 fix	20
C6(CL6)	1	35°53’34”	35°28’31”	Latakia	6.Snawbar		Sta.	Fa.Better	5	10 cover	10
C7(CL8)	2	35°54’37”	35°26’52”	Latakia	7.Kabo		Sta.	Fa.better	5	25 fix	30
C8(CL9)	3	35°55’35”	35°24’52”	Latakia	8.Al Roos		Sta.	Fa.better	5	20 fix	20
C9(CL10)	5	° ’ ”	° ’ ”	Latakia	9.Zerod		Sta.		5	10 fix	10
C10(CL11)	8	° ’ ”	° ’ ”	Latakia	10.Sakhabah		Sta.		4	5 fix	10
C11(CL12)	10	35°57’44”	35°15’59”	Latakia	11.Sinn		Sta.		4	5 cover	10
C12(CL13)	11	35°57’57”	35°15’ 8”	Latakia	11.Soreet		Sta.	Move to downstream	3	5 cover	10
C13(CL14)	1	° ’ ”	° ’ ”	Tartus	12.Haraesoon		Sta.Br. Fa.		4	15 cover	20
C14(CT1)	2	° ’ ”	° ’ ”	Tartus	13.Jobar		Sta.	Fa.Better	4	15 cover	20
C15(CT2)	28	° ’ ”	° ’ ”	Tartus	13.Jobar		Sta.Br.	Access no good	4	15 cover	20
C16(CT3)	30	° ’ ”	° ’ ”	Tartus	14.Baniyas		Sta.		3.5	5 fix	10
C17(CT5)	33	° ’ ”	° ’ ”	Tartus	17.Hosein		Sta.Br.		3	10 cover	10
C18(CT6)	32	° ’ ”	° ’ ”	Tartus	18.Ghamqah		Sta.	River imp. ongoing	7	30 cover	30
C19(CT8)	29	° ’ ”	° ’ ”	Tartus	21.Kabar Janoubi		Equip.only	National Boundary	5	10	10

Note: Fix.: Fix the protection pipe of censor/cable along concrete surface or structure

Cover: embed the protection pipe and cover by soils or rocks

3) Equipment for groundwater observation

The items and general specifications of the equipment for groundwater observation are as follows:

- Portable water level meter: ..... Measuring cable with water level sensor, Depth: 300 m

  Number of the equipment: GDBAB- 4sets of 300 m meter, GDCB- 4sets of 300 m meter, MC- one set of 300 m meter, Total- nine sets of 300 m meter

- Data logger..... Cable with water level sensor of (Automatic groundwater level recorder) pressure type and data logger, Depth: 25 m, 50 m, 75 m, 100 m, 150 m, 200 m, 275 m

  Number of the equipment:

Depth (m)	25	50	75	100	150	200	250	275	Total
GDBAB	14	30	20	25	10	8	1	2	110
GDCB	16	12	3	0	2	1	0	0	34
Total	32	42	23	25	12	9	1	2	144

- Data logger with cable sensor..... Cable with water level sensor of (Automatic groundwater level and quality recorder) pressure type and water quality sensors (temperature, pH, EC), and data logger, Depth: 25 m, 50 m, 75 m, 100 m, 125 m, 150 m, 175 m

  Number of the equipment:

Depth (m)	25	50	75	100	150	200	Total
GDBAB	2	8	9	9	3	2	33
GDCB	9	3	1	0	0	0	13
Total	11	11	10	9	3	2	46

Installation plans of data logger (automatic groundwater level recorder) and data logger with cable sensor (automatic groundwater level and quality recorder) are shown in Figure 2-3 (1) (Barada-Awaj Basin) and Figure 2-3 (2) (Coastal Basin).

All the automatic equipment mentioned above will be installed in the existing observation wells. Though all the wells are not necessarily protect, the observation wells to be installed with the automatic equipment should be protected prior to the installation of the equipment. It was agreed upon that Syrian Side shall do such protection works prior to the installation by Japanese Side.

① Portable water level meter

Since the groundwater level measurement is being made in inaccurate way, using hand-made electric wire cable, the use of portable water level meter is proposed for more accurate monitoring. This meter will be used for checking the water levels of the automatic water level stations and measurement of other well water levels.

The requested portable level meter included temperature sensor, however, it was agreed upon through the discussions with Syrian side that the temperature sensor be excluded because the temperature data was not important for the water resources management. As the groundwater level depth of the monitoring wells to be measured with portable water level meters ranges from few meters to more than 250 m, the tape length of 300 m is proposed for fieldwork.

Four teams will be organized for groundwater monitoring activities in GDBAB and GDBAB, respectively, and one team will be organized in MC. It is proposed that the all of the teams will be equipped with a potable water meter.

② Automatic groundwater level recording system

Present monitoring system for the management of groundwater resources is not sufficient because continuous measurement of the groundwater levels is being made by several automatic groundwater level recorders in the Study Area. It is proposed that the automatic groundwater level recorders should be installed in the selected observation wells. The data obtained from this, together with those obtained from the proposed well logging equipment and automatic water quality recording system, will give the useful information for the hydro-geologic characteristics for water resources management.

The temperature sensor is excluded based on the discussions with Syrian side.

The sensor is proposed to set 20 m below normal groundwater level considering the possible water level variation due to precipitation and water use. As shown in Tables 2-4 (1), 2-4 (2) and 2-4 (3), the cable length ranges from a few meters to 300m, therefore, seven types of the cable length are proposed.

The automatic groundwater level recording system is planned to be installed covering the whole area of the both basins in order to grasp the regional groundwater level decline as shown in Figure 2-3 (1) and Figure 2-3 (2). The stations outside the Study Area and ones, which exceed the cable length of 300m, are excluded as mentioned before.

③ Automatic groundwater level and quality recording system

Present monitoring system of the groundwater quality is not sufficient because only two automatic groundwater quality recorders are installed in the Study Area. Therefore, automatic groundwater quality recording system with groundwater level sensors to be installed in the selected observation wells is proposed.

Data logger with cable sensor (Automatic groundwater level and quality recorder) will be used for monitoring of not only groundwater level but also groundwater quality. Proposed monitoring items are electric conductivity (EC), temperature and pH. The sensors are proposed to set about 20m below normal well water levels based on the same idea as that of the automatic water level recording system. As shown in Tables 2-4 (1), 2-4 (2) and 2-4 (3), the lengths of cables ranges from a few meters to 150 m, six types the cable lengths are proposed.

Locations of the proposed automatic groundwater stations are shown in Figures 2-3 (1) and 2-3 (2).

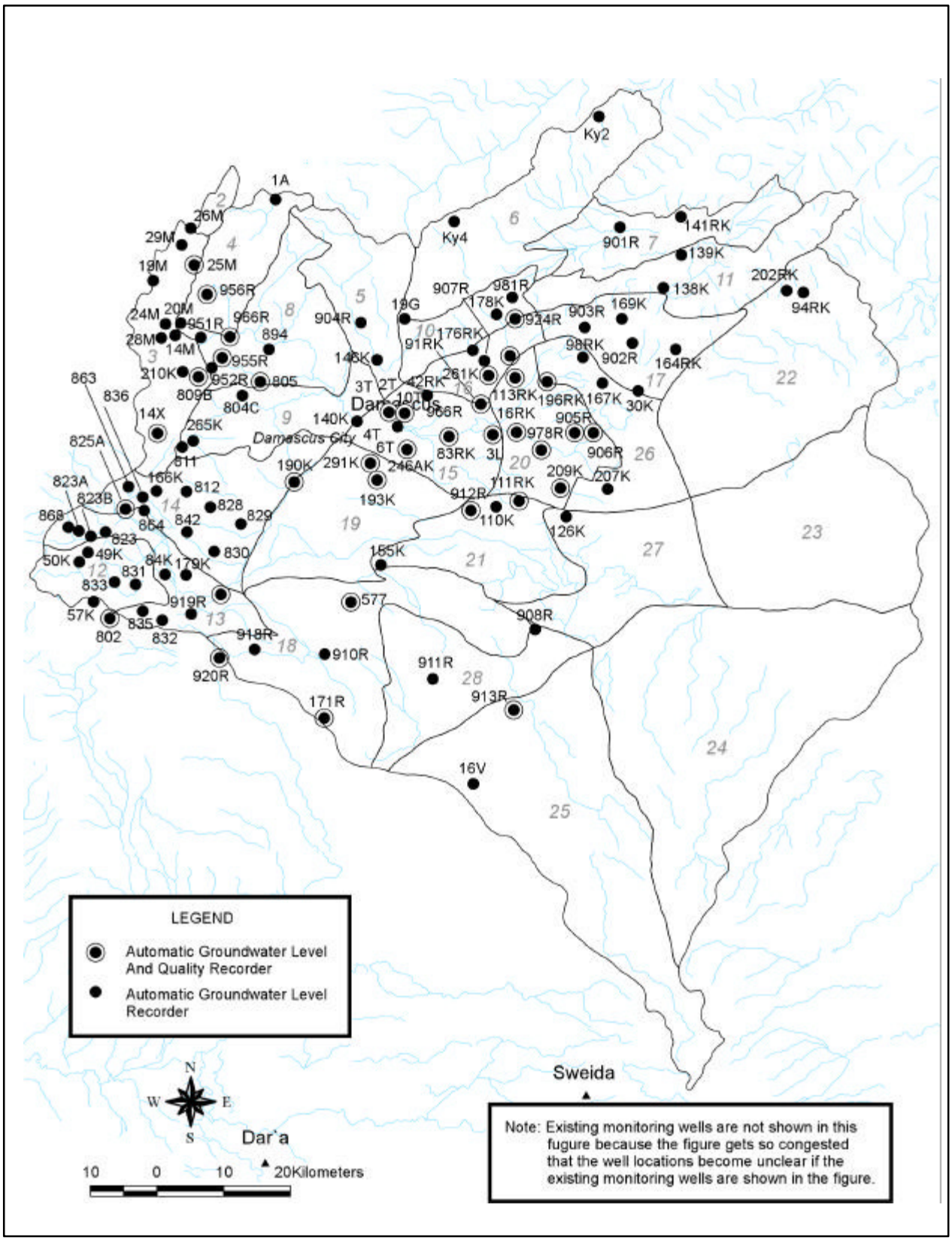


Figure 2-3 (1) Location Map of Proposed Groundwater Level Stations and Groundwater Level/Quality Stations (Barada-Awaj Basin)

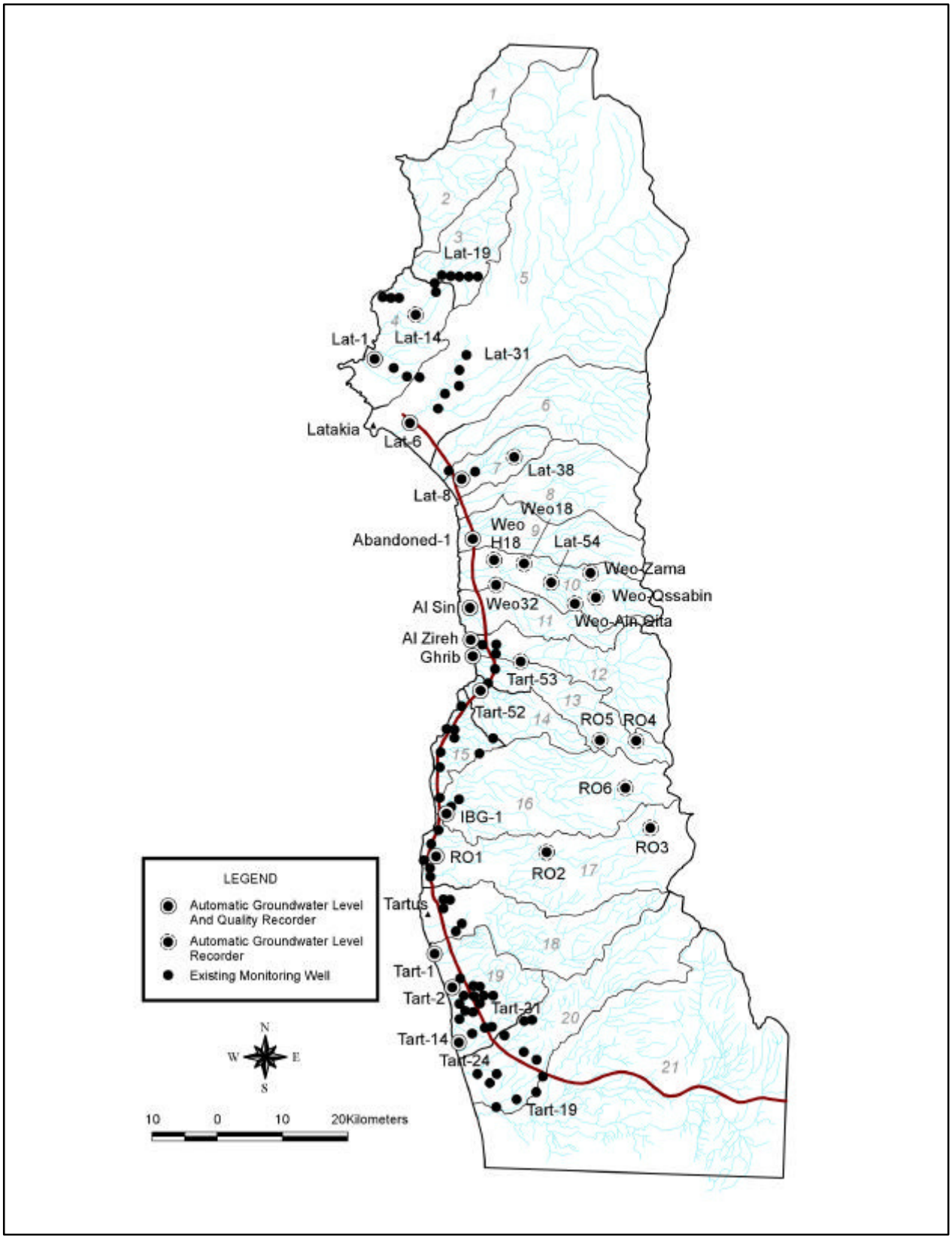


Figure 2-3 (2) Location Map of Proposed Groundwater Level Stations and Groundwater Level/Quality Stations (Coastal Basin)

Table 2-4 (1) Installation Plan of Proposed Groundwater Level Stations and Groundwater Level/Quality Stations

Barada-Awaj Basin: Gota

Well No.	Coordinates X	Coordinates Y	Well Dia. (mm)	Well Dep. D(m)	d (m)	Sensor W. Level	Sensor W. Quality	L (m)	D/R Box stand	D/R Box box
911R	33 ° 13 ' 2 "	36 ° 22 ' 32 "	100	167	35	○		75		○
910R	33 ° 14 ' 55 "	36 ° 13 ' 13 "	80	190	62	○		100		○
913R	33 ° 11 ' 18 "	36 ° 28 ' 31 "	120	250	110	○	○	150		○
209K	33 ° 26 ' 22 "	36 ° 33 ' 3 "	170	100	70	○	○	100		○
207K	33 ° 26 ' 9 "	36 ° 37 ' 2 "	150	106	40	○		75		○
126K	33 ° 24 ' 14 "	36 ° 33 ' 34 "	200	82	60	○		100		○
577	33 ° 18 ' 44 "	36 ° 14 ' 48 "	270	75	44	○	○	75		○
16RK	33 ° 30 ' 18 "	36 ° 29 ' 9 "	150	62	17	○	○	50		○
905R	33 ° 30 ' 6 "	36 ° 34 ' 8 "	100	150	85	○	○	150		○
906R	33 ° 29 ' 39 "	36 ° 35 ' 40 "	110	156	61	○	○	100		○
908R	33 ° 16 ' 27 "	36 ° 31 ' 19 "	150	130	56	○		100		○
146RK	33 ° 35 ' 92 "	36 ° 16 ' 57 "	130	164	17	○		50		○
904R	33 ° 33 ' 7 "	36 ° 15 ' 29 "	90	101	7	○		50		○
19G	33 ° 41 ' 1 "	36 ° 21 ' 17 "	350	120	70	○		100		○
193K	33 ° 27 ' 1 "	36 ° 17 ' 13 "	210	251	37	○	○	75		○
246AK	33 ° 29 ' 12 "	36 ° 19 ' 46 "	90	63	34	○	○	75		○
111RK	33 ° 25 ' 40 "	36 ° 29 ' 11 "	150	150	20	○	○	50		○
110K	33 ° 25 ' 6 "	36 ° 27 ' 44 "	90	33	11	○		50		○
912R	33 ° 24 ' 36 "	36 ° 25 ' 43 "	150	135	71	○	○	100		○
907R	33 ° 35 ' 21 "	36 ° 26 ' 15 "	150	160	20	○		50		○
112RK	33 ° 35 ' 3 "	36 ° 28 ' 31 "	350	210	9	○	○	50		○
113RK	33 ° 34 ' 6 "	36 ° 28 ' 59 "	150	155	22	○	○	50		○
96RK	33 ° 33 ' 50 "	36 ° 31 ' 45 "	100	125	70	○	○	100		○
261K	33 ° 34 ' 14 "	36 ° 26 ' 35 "	170	250	5	○	○	25		○
91RK	33 ° 0 0 "	36 ° 0 ' 0 "	90	55	11	○	○	50		○
167K	33 ° 33 ' 36 "	36 ° 36 ' 21 "	170	100	16	○		50		○
903R	33 ° 31 ' 29 "	36 ° 34 ' 40 "	100	151	26	○		50		○
169K	33 ° 38 ' 6 "	36 ° 37 ' 49 "	150	101	51	○		75		○
918R	33 ° 14 ' 19 "	36 ° 6 ' 4 "	110	350	63	○		100		○
141RK	33 ° 45 ' 26 "	36 ° 43 ' 15 "	100	127	85	○		150		○
138K	33 ° 40 ' 7 "	36 ° 41 ' 50 "	125	80	45	○		75		○
139K	33 ° 42 ' 26 "	36 ° 42 ' 53 "	100	100	25	○		50		○
164RK	33 ° 33 ' 0 "	36 ° 39 ' 51 "	90	150	51	○		75		○
30K	33 ° 33 ' 1 "	36 ° 39 ' 51 "	85	41	30	○		75		○
94RK	33 ° 39 ' 38 "	36 ° 53 ' 38 "	100	129	66	○		100		○
902R	33 ° 36 ' 22 "	36 ° 38 ' 53 "	100	150	77	○		100		○
98RK	33 ° 35 ' 24 "	36 ° 34 ' 40 "	100	132	77	○		100		○
202RK	33 ° 39 ' 43 "	36 ° 51 ' 47 "	160	165	71	○		100		○
291K	33 ° 28 ' 13 "	36 ° 16 ' 34 "	160	120	40	○	○	75		○
171RK	33 ° 9 ' 43 "	36 ° 13 ' 5 "	90	150	52	○	○	75		○
901R	33 ° 44 ' 28 "	36 ° 37 ' 33 "	90	115	58	○		100		○
155K	° ' "	° ' "	150		35	○		75		○
16V	° ' "	° ' "	250		145	○		200		○
978R	° ' "	° ' "	150		60	○	○	100		○
83RK	° ' "	° ' "	150		20	○		50		○
Sub-Total						45	18		0	45

Barada-Awaj Basin: Kalamon

Well No.	Coordinates X	Coordinates Y	Well Dia. (mm)	Well Dep. D(m)	d (m)	Sensor W. Level	Sensor W. Quality	L (m)	D/R Box stand	D/R Box box
Ky2	33 ° 54 ' 22 "	36 ° 36 ' 4 "	220		103	○		150		○
Ky4	33 ° 47 ' 14 "	36 ° 24 ' 33 "	200	316	247	○		275		○
Sub-Total						2	0		0	2

Table 2-4 (2) Installation Plan of Ground Water Level Stations and Groundwater Level /Quality Stations

Barada-Awaj Basin: Haramon

Well No.	Coordinates X	Coordinates Y	Well Dia. (mm)	Well Dep. D(m)	d (m)	Sensor W. Level	Sensor W. Quality	L (m)	D/R Box stand	D/R Box box
2T	33° 31' 43"	36° 14' 58"	150	67	25	○		50	○	
3T	33° 15' 22"	36° 18' 47"	150	65	25	○		50	○	
4T	33° 31' 35"	36° 18' 15"	140	78	25	○	○	50		○
831	33° 17' 59"	35° 57' 48"	150	50	4	○		25		○
179K	33° 20' 38"	35° 59' 34"	220		21	○		50		○
184K	33° 20' 35"	35° 59' 18"	220		7	○		50		○
842	33° 31' 38"	36° 18' 26"	220		30	○		50		○
828	33° 24' 55"	36° 2' 7"	150		65	○		100		○
832	33° 17' 56"	35° 52' 42"	150		7	○		50		○
833	33° 18' 3"	35° 57' 27"	220		4	○		25		○
46K	33° 19' 13"	36° 4' 34"	100		7	○	○	50		○
829	33° 24' 3"	36° 5' 48"	220		40	○		75		○
10T	33° 31' 49"	36° 18' 50"	150		31	○	○	75		○
6T	33° 31' 36"	36° 18' 21"	150		28	○		50		○
I	33° 31' 43"	36° 18' 13"	2,000		25	○		50	○	
190K	33° 27' 3"	36° 10' 13"	220		87	○	○	150		○
25M	33° 40' 57"	41° 23' 53"	500		34	○	○	75		○
19M	33° 40' 5"	36° 0' 16"	220		46	○		75		○
29M	33° 45' 36"	36° 1' 2"	350		132	○		200		○
26M	33° 46' 0"	36° 1' 8"	350		180	○		200		○
176RK	34° 14' 3"	36° 24' 13"	250		170	○		200	○	
805	33° 34' 6"	36° 7' 6"	200		153	○	○	200		○
804C	33° 33' 7"	36° 5' 33"	210		187	○		275		○
952R	33° 35' 44"	36° 3' 45"	90		3	○		25		○
210K	33° 52' 36"	36° 5' 39"	450		215	○		275		○
951R	33° 37' 15"	36° 1' 52"	110		33	○		75		○
178K	33° 38' 32"	36° 27' 17"	220		165	○		200		○
28M	33° 37' 27"	41° 59' 37"	220		123	○		150		○
20M	33° 38' 15"	41° 58' 48"	80		2	○		25		○
14M	33° 15' 42"	41° 25' 22"	220		97	○		150		○
24M	33° 38' 13"	41° 58' 37"	160		110	○		150		○
1A	33° 17' 56"	35° 52' 42"	1,500		2	○		25	○	
894	33° 36' 23"	36° 7' 48"	150		78	○		100		○
140K	33° 31' 15"	36° 15' 21"	100		3	○		25		○
830	33° 22' 25"	36° 3' 45"	220		70	○		100		○
835	33° 17' 42"	35° 57' 38"	150		9	○		50		○
265K	33° 30' 4"	36° 1' 21"	220		40	○		75		○
920R	33° 15' 96"	35° 59' 0"	250		30	○	○	50		○
919R	33° 16' 42"	36° 0' 52"	250		56	○		100		○
57K	33° 18' 48"	35° 53' 29"	80		4	○		25		○
811	33° 9' 34"	36° 0' 33"	200		141	○		200		○
49K	33° 22' 13"	35° 52' 46"	80		4	○		25		○
50K	33° 21' 43"	35° 51' 25"	80		4	○		25		○
868	33° 22' 46"	35° 52' 44"	240		24	○		50		○
823	33° 22' 38"	35° 52' 46"	240		6	○		50		○
823A	33° 22' 34"	35° 52' 40"	150		5	○		25		○
823B	33° 22' 33"	35° 52' 38"	220		0.5	○		25		○
166K	33° 25' 8"	35° 57' 32"	200		10	○		50		○
836	33° 23' 41"	35° 54' 22"	100		9	○		50		○
863	33° 23' 42"	35° 54' 11"	300		18	○		50		○
825A	33° 23' 37"	35° 54' 13"	200		5	○	○	25		○
864	33° 23' 29"	35° 54' 14"	350		1	○		25		○
3L	33° 30' 4"	36° 27' 14"	200		40	○	○	75	○	
42K	33° 33' 3"	36° 21' 24"	220		62	○		100		○
802	33° 15' 59"	35° 50' 39"	150		129	○		150		○
924R	33° 33' 16"	36° 28' 42"	150		70	○	○	100		○
14RX	° ' "	° ' "	150		150	○	○	200		○
812	° ' "	° ' "	200		108	○		150		○
966R	° ' "	° ' "	140		40	○	○	75		○
981R	° ' "	° ' "	145		80	○		100		○
809B	° ' "	° ' "	300		60	○	○	100		○
955R	° ' "	° ' "	150		60	○	○	100		○
956R	° ' "	° ' "	150		60	○	○	100		○
Sub-Total						63	15		6	57

Table 2-4 (3) Installation Plan of Ground Water Level Stations and Groundwater Level /Quality Stations

Coastal Basin: Latakia

Well No.	Coordinates X	Coordinates Y	Well Dia. (mm)	Well Dep. D(m)	d (m)	Sensor W. Level	Sensor W. Quality	L (m)	D/R Box stand	D/R Box box
Lat-1	36 ° 46 ' 31 "	35 ° 36 ' 5 "	300	10	3	○	○	25	○	
Lat-6	35 ° 50 ' 46 "	35 ° 35 ' 3 "	320	35	0.4	○		25	○	
Lat-8	35 ° 55 ' 4 "	35 ° 27 ' 3 "	2×2m	7	2	○	○	25	○	
Lat-14	35 ° 50 ' 23 "	35 ° 39 ' 27 "	200	25	0.7	○		25	○	
Lat-19	35 ° 54 ' 15 "	35 ° 42 ' 26 "	300	18	0.8	○		25	○	
Lat-25	35 ° 50 ' 28 "	35 ° 31 ' 14 "	900	6	0.5	○	○	25	○	
Lat-31	35 ° 55 ' 25 "	35 36 ' 24 "	320	70	10	○		50	○	
Lat-33	36 ° 0 ' 0 "	35 ° 28 ' 58 "	300	70	15	○		50	○	
Aband.1	° ' "	° ' "	3,000		2	○	○	25	○	
Weo-H8	36 ° 1 ' 24 "	35 ° 20 ' 12 "	100		1	○		25	○	
Weo-32	36 ° 1 ' 30 "	35 ° 19 ' 12 "	150		25	○		50	○	
Weo-18	36 ° 2 ' 35 "	35 ° 19 ' 54 "	150		11	○		50	○	
Weo-Zama	36 ° 3 ' 56 "	35 ° 21 ' 26 "	150		145	○		200	○	
Weo-Qssabin	36 ° 1 ' 23 "	35 ° 19 ' 53 "	100		25	○		50	○	
Weo-Ain Qita	36 ° 7 ' 5 "	35 ° 18 ' 44 "	200		125	○		150	○	
Weo-Al Sin	35 ° 57 ' 53 "	35 ° 15 ' 47 "	500		25	○	○	50	○	
Sub-Total						16	5		16	0

Coastal Basin : Tartus

Well No.	Coordinates X	Coordinates Y	Well Dia. (mm)	Well Dep. D(m)	d (m)	Sensor W. Level	Sensor W. Quality	L (m)	D/R Box stand	D/R Box box
Tart-1	35 ° 54 ' 2 "	34 ° 50 ' 13 "	350	12	1	○	○	25	○	
Tart-2	35 ° 55 ' 1 "	34 ° 47 ' 47 "	300	63	4	○	○	25	○	
Tart-14	35 ° 56 ' 27 "	34 ° 44 ' 0 "	360	10	0.5	○	○	25	○	
Tart-19	36 ° 2 ' 12 "	34 ° 40 ' 8 "	300	40	0.5	○		25	○	
Tart-24	36 ° 0 ' 39 "	34 ° 42 ' 30 "	430	50	1	○		25	○	
Tart-31	35 ° 59 ' 36 "	34 ° 44 ' 43 "	400	20	0.5	○		25	○	
Tart-52	35 ° 57 ' 19 "	35 ° 10 ' 56 "	300	75	15	○	○	50	○	
Tart-53	36 ° 1 ' 4 "	35 ° 13 ' 11 "	270		83	○		150	○	
Tart-54	35 ° 4 ' 35 "	35 ° 19 ' 33 "	150		25	○		50	○	
Al Zireh	35 ° 58 ' 50 "	35 ° 13 ' 18 "	200		3	○	○	25	○	
Ghrib	35 ° 57 ' 22 "	35 ° 13 ' 38 "	250		3	○	○	25	○	
IBG 1	° ' "	° ' "	250		10	○	○	50	○	
RO 1	35 ° 53 ' 36 "	34 ° 55 ' 44 "	150		40	○	○	75	○	
RO 2	36 ° 6 ' 41 "	34 ° 58 ' 57 "	150		25	○		50	○	
RO 3	36 ° 12 ' 49 "	35 ° 0 ' 10 "	150		12	○		50	○	
RO 4	36 ° 11 ' 20 "	35 ° 6 ' 57 "	150		40	○		75	○	
RO 5	36 ° 8 ' 8 "	35 ° 4 ' 22 "	150		12	○		50	○	
RO 6	36 ° 11 ' 44 "	35 ° 3 ' 7 "	150		50	○		75	○	
Sub-Total						18	8		18	0

4) Related Equipment

The items and general specifications of the related equipment are as follows:

- Water sampler ..... For groundwater sampling, Sampling volume: 1.0 litter
- Well logging equipment..... Logging items: Specific resistance, conductivity, spontaneous potential, temperature, natural gamma ray, caliper
  Logging Depth: 300m
- Field vehicle- ..... 4WD vehicle, to be used for monitoring work in the field

① Water sampler

The water sampler is needed for detailed groundwater quality analysis in the laboratory in case that the automatic groundwater quality recorders detected the groundwater quality deterioration in the observation wells. This equipment will also be used for in other wells than the automatic ones.

Four teams will be organized for groundwater monitoring activities in GDBAB and GDBAB respectively, and one team will be organized in MC. One set of water sampler for each team, 9 sets in total, is proposed.

② Well logging equipment

Well logging equipment with a logging depth of more than 1500m was agreed in M/D on Draft Report, however, reviewed carefully in Japan as follows:

a. Necessity of the well logging equipment

- There are 270 groundwater-monitoring wells in the Study Area, of which 176 wells have well depth data, and the rest, 94 wells, with no data. Almost all of them have no aquifer information because of the scattered and lost the data. Therefore, it is not possible to clarify that the well waters, which being monitored presently, originate from which aquifer. In order to know the hydro-geologic characteristics, as much as possible, for water resources management, usage of well logging equipment is proposed by the following reasons:

- To obtain the necessary the hydro-geological information concerning conditions and structure of the observation wells for the appropriate groundwater management

- GDBAB owns one set of well logging equipment with a logging depth of 1500m, but it is almost out of use because it is too old. New well logging equipment is needed for the replacement of the existing one.

- Though the casing was installed only in the head part of the observation wells and almost all part of the hole remained naked, it was considered that the hydro-geological information could be obtained by the well logging.

b. Logging depth

Logging depth of 300 m is proposed with the reasons below:

- The depth of the existing observation wells ranges from 20 m to 815 m. The deep observation wells are mainly located in the mountainous areas.

- There are many observation wells without their depth data as mentioned above.

- GDBAB is drilling one observation well of 1,800 m in depth and has plans to do well logging work in such deep wells in the future. However, it does not mean that a deep logging is necessary.

- Deep groundwater is generally small in volume or fossil water, which is not suitable sustainable use of groundwater especially for Damascus and its surrounding areas.

- Equipment with logging depth of 1500 will require exclusive car, and it is not commonly manufactured if cover the proposed measuring items.

- Wells with depth more than 300 m are located in the mountain areas. Out of 176 wells, 9 wells (5 %) exceed the well depth of 300 m. Much information could be obtained from the existing observation wells.

c. Logging items

- The following measuring items are proposed:

- Resistivity (Specific resistance):

  To know coarse or fine of rocks or soils (clay or sand, etc), Water condition (location of aquifer)

- Electric conductivity:
  To know salinity and impurity

- Spontaneous potential:

  To check movement of water from aquifer

- Temperature:

  To infer the groundwater flow condition based on the vertical change of the groundwater temperature

- Natural gamma ray:

  To know the rock characteristics (soft or hard, fault, clay, etc)

- Caliper (well diameter):

  To know well size and also geologic conditions and collapse condition

③ Field vehicle

- The number of the monitoring points will be increased after the implementation of this Project, and GDBAB and GDCB are planning to organize additional two observation teams respectively corresponding to the increase in monitoring points. For this reason, it is considered that the additional four field vehicles of 4WD type will be required for the new observation teams of GDBAB and GDCB. Present and proposed monthly monitoring activities are shown in Table 2-5: In GDCB, one car needs 3 times/month of inspection and repair as required and one car will be required in near future. In total, five field vehicles are proposed.

Table 2-5 Field Monitoring Work Plan

Present monitoring practices

(monthly)

Day	10	20	30
GDBAB			
Hydrological/Meteorological observation team			
Team 1 (vehicle 1)			
Team 2 (vehicle 2)			
Team 3 (vehicle 3)			
Groundwater observation team			
Team 1 (vehicle 4)			
Team 2 (vehicle 5)			
Team 3 (vehicle 6)			
GDCB			
LATAKIA			
Team 1 (vehicle 1)			
Team 2 (vehicle 2)			
Team 3 (vehicle 3)			
TARTUS			
Team 1 (vehicle 4)			
Team 2 (vehicle 5)			
Team 3 (vehicle 6)			

Propose monitoring practices after the Project

(monthly)

Day	10	20	30
GDBAB			
Hydrological/Meteorological observation team			
Team 1 (vehicle 1)			
Team 2 (vehicle 2)			
Team 3 (vehicle 3)			
Team 4 (vehicle 4)			
Groundwater observation team			
Team 1 (vehicle 5)			
Team 2 (vehicle 6)			
Team 3 (vehicle 7)			
Team 4 (vehicle 8)			
GDCB			
LATAKIA			
Team 1 (vehicle 1)			
Team 2 (vehicle 2)			
Team 3 (vehicle 3)			
Team 4 (vehicle 4)			
TARTUS			
Team 1 (vehicle 5)			
Team 2 (vehicle 6)			
Team 3 (vehicle 7)			
Team 4 (vehicle 8)			

(3) Equipment Plan

Main equipment proposed in this basic design is listed in Table 2-6.

Table 2-6 (1) List of Main Equipment

No	Name of Equipment	Main Specifications or Components	Proposed Quantity	Unit
A	**Metrological Observation**			
A-1	Automatic weather observation system			
A-1-1	Automatic weather observation system Equipment components	Measuring items: Wind speed and direction, Air temperature/Relative humidity, Global radiation, Sunshine hours, Rainfall Components: Sensor, Data logger, Solar panel system Pole (H=10m)	21	Set
A-1-2	Automatic weather observation system Spare parts	Wind speed and direction, Air temperature/Relative humidity, Global radiation, Sunshine hours, Rainfall, and Data logger	2	Set
A-2	Snow observation equipment	Equipment to get snowfall amount from accumulated snow volume		
A-2	Snow observation equipment			
A-2-1	Snow scale (Pole)	Height: 2m, Graduation: 1cm	22	Set
A-2-2	Snow sampler	Acrylic cylinder type sampler, Edge diameter: about 5cm, Area: about 20cm^2, Length: about 50cm	22	Set
A-2-3	Digital weight balance	Weighing: About 6kg, Minimum display: About 0.002kg	22	Set
A-3	Auto recording rainfall system			
A-3-1	Auto recording rainfall system Equipment components	Rain gauge: Tipping bucket type, Measuring range: 0. 5mm/tipping, Data Logger, Solar panel system	24	Set
A-3-2	Auto recording rainfall system Spare parts	Tipping bucket type rain gauge and Data logger	2	Set
A-3-3	Auto recording rainfall system Software	Software to extract data from data logger	4	Set
A-4	Auto recording evaporation system			
A-4-1	Auto recording evaporation system Equipment components	Type: Standard-A pan, Diameter: 1200mm, Height: About 280mm Evaporation pan, Measuring device, Data logger, Solar panel system	6	Set
A-4-2	Auto recording evaporation system Spare parts	Measuring device and Data logger	1	Set
A-4-3	Auto recording evaporation system Software	Software to extract data from data logger	4	Set
A-5	Computer for data collection	Type: Note type, Display: 14.1 inches or more, CPU: Pentium III more than 1GMHz, HD: More than 40GB, Memory: More than 256MB, OS: Windows 98 (English) or more, Others: with CD-RW drive	9	Set
A-6	Field Vehicle	Type: Pick up type/Double cabin, Driving type: 4 x 4, Load capacity: more than 0.5 ton	5	Unit

Table 2-6 (2) List of Main Equipment

No	Name of Equipment	Main Specifications or Components	Proposed Quantity	Unit
B	**Surface Water/Groundwater Observation**			
B-1	Portable auto current meter			
B-1-1	Portable auto current meter 1	Measuring range: More than 0.1～3m/s, Display: Digital display, Cable length: About 10m	5	Unit
B-1-2	Portable auto current meter 2	Measuring range: More than 0.1～6m/s, Display: Digital display, Cable length: About 10m	4	Unit
B-2	Auto surface water level measuring system			
B-2-1	Auto surface water level measuring system (For river)	Type: Pressure type, Measuring range: 10m, Cable length: 30m, Water level gauge, Data logger/storage box (Stand type)	52	Set
B-2-2	Auto surface water level measuring system (For dam)	Type: Pressure type, Measuring range: 10m, Cable length: 50m, Water level gauge, Data logger/storage box (Stand type)	1	Set
B-2-3	Auto surface water level measuring system Spare parts	Type: Pressure type, Measuring range: 10m, Cable length: 30m, Water level gauge, and Data logger	2	Set
B-2-4	Auto surface water level measuring system, Software	Software to extract data from data logger	4	Set
B-3	Potable water quality meter			
B-3-1	EC meter	Type: Handy type, Measuring range: 0-1,999 μS or 0~199.9mS or more, Accuracy: ±1% (for full -scale), with Reserve electrode	18	Unit
B-3-2	pH meter	Type: Handy type, Measuring range: More than 0-14 pH, Resolution: More than 0.1 pH, Measuring accuracy: Within 0.2pH, with Reserve electrode	18	Unit
B-3-3	DO meter	Type: Handy type, Measuring range: More than 0-19.9mg/L, Resolution: More than 0.1%, Measuring accuracy: Within ± 1%, with Reserve electrode	18	Unit
B-4	Portable groundwater level meter	Type: Sealed steel rope type, Measuring depth: 300m, Minimum graduation: 10mm, Water level sensor: Buzzer type, with thermometer	9	Unit
B-5	Auto groundwater level recording system			
B-5-1	Auto groundwater level recording system 1	Type: Pressure type gauge, Cable length: 30m, Measuring depth: 20m below water level, Water level gauge, Data logger/Storage box (stand type)	17	Set
B-5-2	Auto groundwater level recording system 2	Type: Pressure type gauge, Cable length: 50m, Measuring depth: 20m below water level, Water level gauge, Data logger//Storage box (stand type)	15	Set
B-5-3	Auto groundwater level recording system 3	Type: Pressure type gauge, Cable length: 80m, Measuring depth: 20m below water level, Water level gauge, Data logger/Storage box (stand type)	4	Set
B-5-4	Auto groundwater level recording system 4	Type: Pressure type gauge, Cable length: 150m, Measuring depth: 20m below water level, Water level gauge, Data logger/Storage box (stand type)	2	Set
B-5-5	Type: Pressure type gauge	Type: Pressure type gauge, Cable length: 200m, Measuring depth: 20m below water level, Water level gauge, Data logger/Storage box (stand type)	2	Set

Table 2-6 (3) List of Main Equipment

No	Name of Equipment	Main Specifications or Components	Proposed Quantity	Unit
B-5-6	Auto groundwater level recording system 6	Type: Pressure type gauge, Cable length: 30m, Measuring depth: 20m below water level, Water level gauge, Data logger/Storage box (stand type)	13	Set
B-5-7	Auto groundwater level recording system 7	Type: Pressure type gauge, Cable length: 50m, Measuring depth: 20m below water level, Water level gauge, Data logger/Storage box (box only)	27	Set
B-5-8	Auto groundwater level recording system 8	Type: Pressure type gauge, Cable length: 80m, Measuring depth: 20m below water level, Water level gauge, Data logger/Storage box (box only)	19	Set
B-5-9	Auto groundwater level recording system 9	Type: Pressure type gauge, Cable length: 100m, Measuring depth: 20m below water level, Water level gauge, Data logger/Storage box (box only)	25	Set
B-5-10	Auto groundwater level recording system 10	Type: Pressure type gauge, Cable length: 150m, Measuring depth: 20m below water level, Water level gauge, Data logger/Storage box (box only)	10	Set
B-5-11	Auto groundwater level recording system 11	Type: Pressure type gauge, Cable length: 200m, Measuring depth: 20m below water level, Water level gauge, Data logger/Storage box (box only)	7	Set
B-5-12	Auto groundwater level recording system 12	Type: Pressure type gauge, Cable length: 250m, Measuring depth: 20m below water level, Water level gauge, Data logger/Storage box (box only)	2	Set
B-5-13	Auto groundwater level recording system 13	Type: Pressure type gauge, Cable length: 300m, Measuring depth: 20m below water level, Water level gauge, Data logger/Storage box (box only)	1	Set
B-5-14	Auto groundwater level recording system, Spare parts 1	Pressure type gauge, Cable length: 30m, Measuring depth: 20m, and Data logger	2	Set
B-5-15	Auto groundwater level recording system, Spare parts 2	Pressure type gauge, Cable length: 50m, Measuring depth: 20m, and Data logger	2	Set
B-5-16	Auto groundwater level recording system, Spare parts 3	Pressure type gauge, Cable length: 80m, Measuring depth: 20m, and Data logger	2	Set
B-5-17	Auto groundwater level recording system, Spare parts 4	Pressure type gauge, Cable length: 100m, Measuring depth: 20m, and Data logger	2	Set
B-5-18	Auto groundwater level recording system, Spare parts 5	Pressure type gauge, Cable length: 150m, Measuring depth: 20m, and Data logger	1	Set
B-5-19	Auto groundwater level recording system, Spare parts 6	Pressure type gauge, Cable length: 200m, Measuring depth: 20m, and Data logger	1	Set
B-5-20	Auto groundwater level recording system, Software	Software to extract data from data logger	4	Set

Table 2-6 (4) List of Main Equipment

No	Name of Equipment	Main Specifications or Components	Proposed Quantity	Unit
B-6	Auto groundwater quality recording system			
B-6-1	Auto groundwater quality recording system 1	Cable length: 30m, Maximum water depth: 20m, Measuring items: EC /pH/ Water temperature Water quality gauge, Data logger	11	Set
B-6-2	Auto groundwater quality recording system 2	Cable length: 50m, Maximum water depth: 20m, Measuring items: EC /pH/ Water temperature Water quality gauge, Data logger	11	Set
B-6-3	Auto groundwater quality recording system 3	Cable length: 80m, Maximum water depth: 20m, Measuring items: EC /pH/ Water temperature Water quality gauge, Data logger	10	Set
B-6-4	Auto groundwater quality recording system 4	Cable length: 100m, Maximum water depth: 20m, Measuring items: EC /pH/ Water temperature Water quality gauge, Data logger	9	Set
B-6-5	Auto groundwater quality recording system 5	Cable length: 150m, Maximum water depth: 20m, Measuring items: EC /pH/ Water temperature Water quality gauge, Data logger	3	Set
B-6-6	Auto groundwater quality recording system 6	Cable length: 200m, Maximum water depth: 20m, Measuring items: EC /pH/ Water temperature Water quality gauge, Data logger	2	Set
B-6-7	Auto groundwater quality recording system, Spare parts 7	Cable length: 30m, Maximum water depth: 20m, and Data logger	1	Set
B-6-8	Auto groundwater quality recording system, Spare parts 8	Cable length: 50m, Maximum water depth: 20m, and Data logger	1	Set
B-6-9	Auto groundwater quality recording system, Spare parts 9	Cable length: 80m, Maximum water depth: 20m, and Data logger	1	Set
B-6-10	Auto groundwater quality recording system, Spare parts 10	Cable length: 100m, Maximum water depth: 20m, and Data logger	1	Set
B-6-11	Auto groundwater quality recording system, Software	Software to extract data from data logger	4	Set
B-7	Water sampler	Water sampling depth: 100m, Water sampling volume: About 1000 cc	9	Unit
B-8	Well logging equipment	Measuring depth: 300 m, Measuring items: Resistivity /Electric conductivity/Spontaneous potential/Water temperature/Natural gamma ray/Well diameter	1	Unit
B-9	Computer for data collection	Type: Note type, Display: 14.1 inches or more, CPU: Pentium III more than 1GMHz, HD: More than 40GB, Memory: More than 256MB, OS: Windows 98 (English) or more, Others: with CD-RW drive	9	Set
B-10	Gabion	Wire diameter. 4 mm – 13 cm x 50 cm x 120 cm	504	Unit

2-2-3 Basic Design Drawing

The installation locations of the equipment in this Project are shown in next table:

Table 2-7 Installation Location and Number of the Equipment

Equipment	GDBAB	**GDCB**	**Total**
I. Equipment for Meteorological Observation			
Automatic weather station	14	7	21
Rain gauge	14	10	24
Recording evaporation gauge	0	6	6
Snow gauge and snow sampler	15	7	22
II. Equipment for Surface Water Observation			
Automatic water level recorder	34	19	53
III. Equipment for Groundwater Observation			
Data logger (Automatic groundwater level recorder)	110	34	144
Data logger with cable (Automatic groundwater level & quality recorder)	33	13	46

Schematic plan of the automatic weather station is shown in Figure 2-4. Basic design drawings of the proposed equipment are sown in Attachment I.

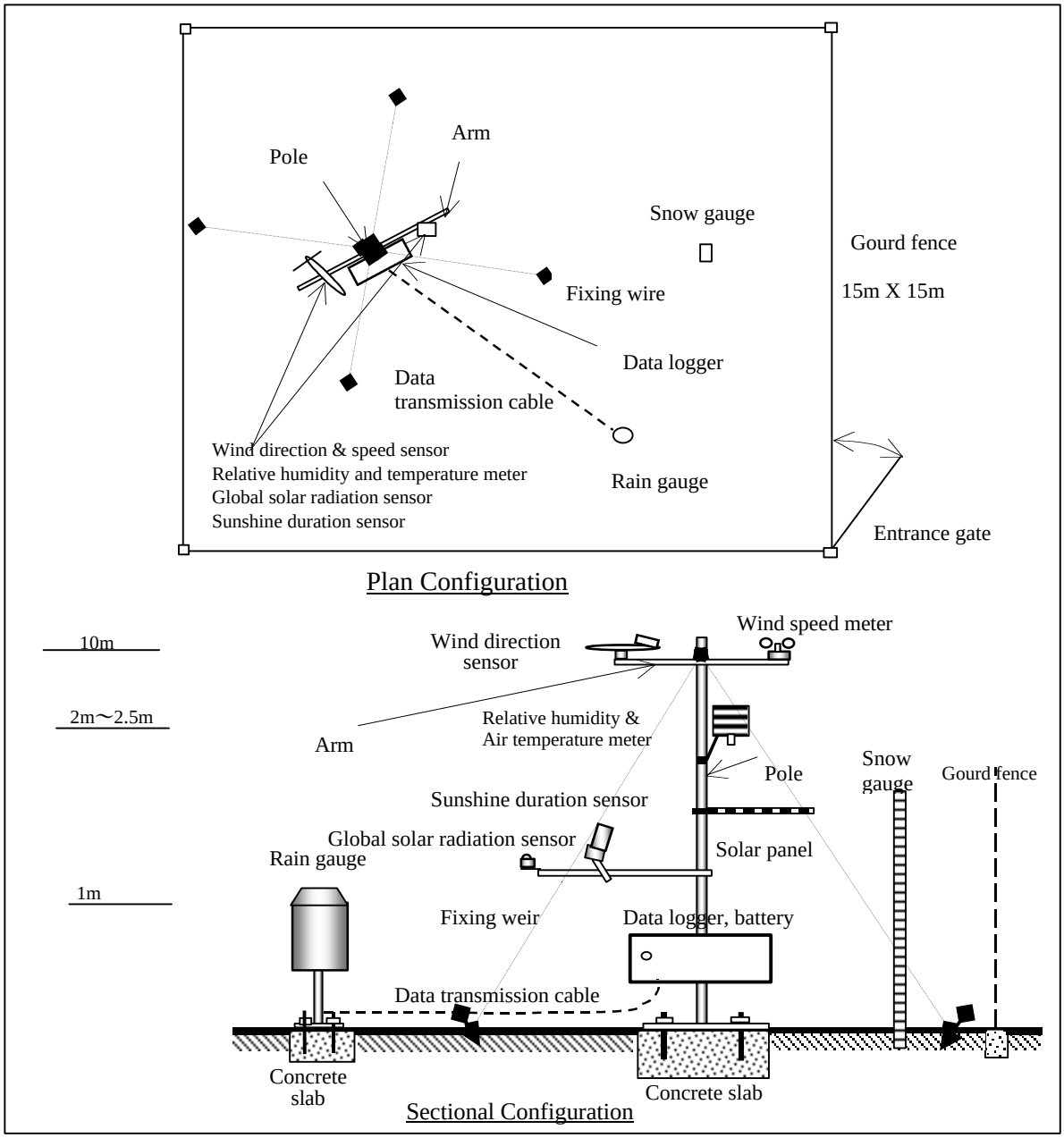


Figure 2-4 Schematic Plan of the Automatic Weather Station

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

In order to complete the development of hydrological and meteorological observation network within the period stipulated in the E/N, it is proposed to dispatch the engineers of necessary fields, and hold discussions with MOI and other related agencies and carry out the Project works based on the basic design and the detailed design.

The procurement of equipment shall be made based on the policies of the Japanese grant aid and the background and objectives of the Project. The equipment with the minimum requirements, with moderate costs and possible to operate and maintain within the budget and technological capability of Syrian counterpart personnel in the future are the basic policies.

2-2-4-2 Implementation Conditions

The implementation agency of Syrian side for the Project is the Ministry of Irrigation (MOI). The General Directorate of Barada-Awaj Basin (GDBAB) and the General Directorate of Coastal Basin (GDCB) and the Main Center of Water Resources Information Center (WRIC) under MOI are the agencies directly concerned with the execution of the Project. In each of GDBAB and GDCB, there is a WRIC and they will mange the equipment to be procured by the Project. Organization chart of the implementation agency is shown in Figure 2-5.

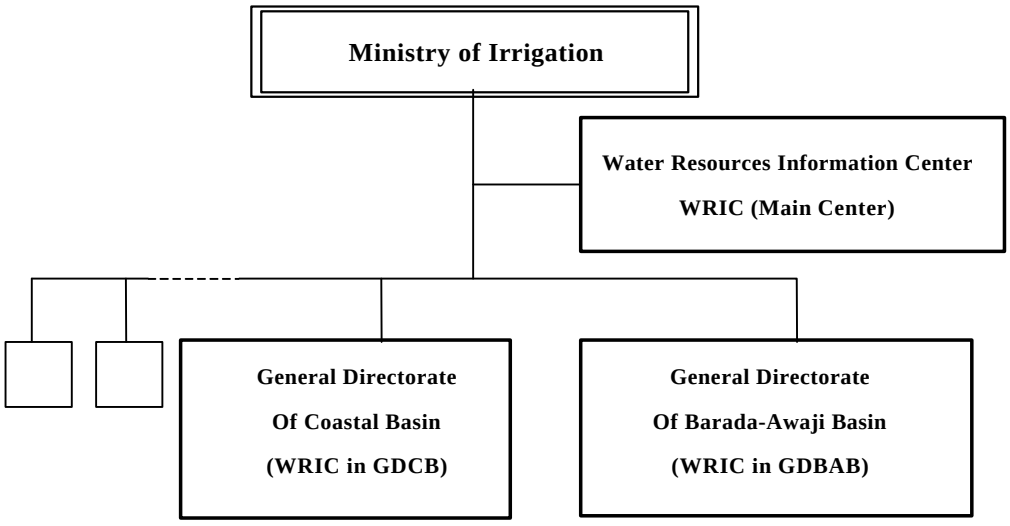


Figure 2-5 Organization Chart of Project Implementation Agency

2-2-4-3 Scope of Works

(1) Scope of Japanese Side

Japanese side will undertake the procurement of the equipment and materials, transportation, carrying in, installation, execution of training, confirmation of operation and handover to Syrian side.

(2) Scope of Syrian Side

Syrian side will undertake the arrangement the necessary conditions for the installation of the equipment that covered by Japanese side such as land acquisition, land grading, storing of the equipment, etc. Syrian side also will undertake the necessary facilities for smooth implementation of Project in Syria.

(3) Scope of Works

The scope of works to be undertaken by both sides is shown in Table 2-8.

Table 2-8 Scope of Works

Work Item	Japanese Side	Syrian Side	Remarks
1. Procurement costs of Equipment and / Materials			
- Procurement	●		
- Packing	●		
- Transportation to the port	●		
- Inland transportation		●	
- Carrying in, Installation & Backup	●		
- Provision of facility to store the equipment		●	
2. Riverbed fairing		●	
3. Tax exemption		●	
4. Custom clearance		●	

2-2-4-4 Consultants Supervision

In order to supply the equipment and materials smoothly during the period from tendering to transport and final set up, the consultant and the supplier should carry out procurement management activities as described below.

The equipment planner of the consultant shall hold a meeting with the supplier to confirm the details of equipment/materials, and shall inspect the equipment before shipping. The supplier shall also dispatch an engineer for the management at the time

of arrival of the equipment and materials at the Tartus Port. The supplier shall explain how to operate and manage the equipment and materials. This explanation will be held in Damascus in consideration of the establishment of operation/maintenance management.

2-2-4-5 Procurement Plan

(1) Equipment and materials for civil works

Equipment and materials for civil works required for installation of equipment, such as concrete, reinforcing bar, small scale steel products, heavy equipment, steel pipe, concrete pipe, etc are available in Syria by lease or purchasing. Heavy equipment and vehicles required for the construction works are available by lease.

(2) Equipment for observation

Procurement of the meteorological and hydrological equipment will be made including from the third countries.

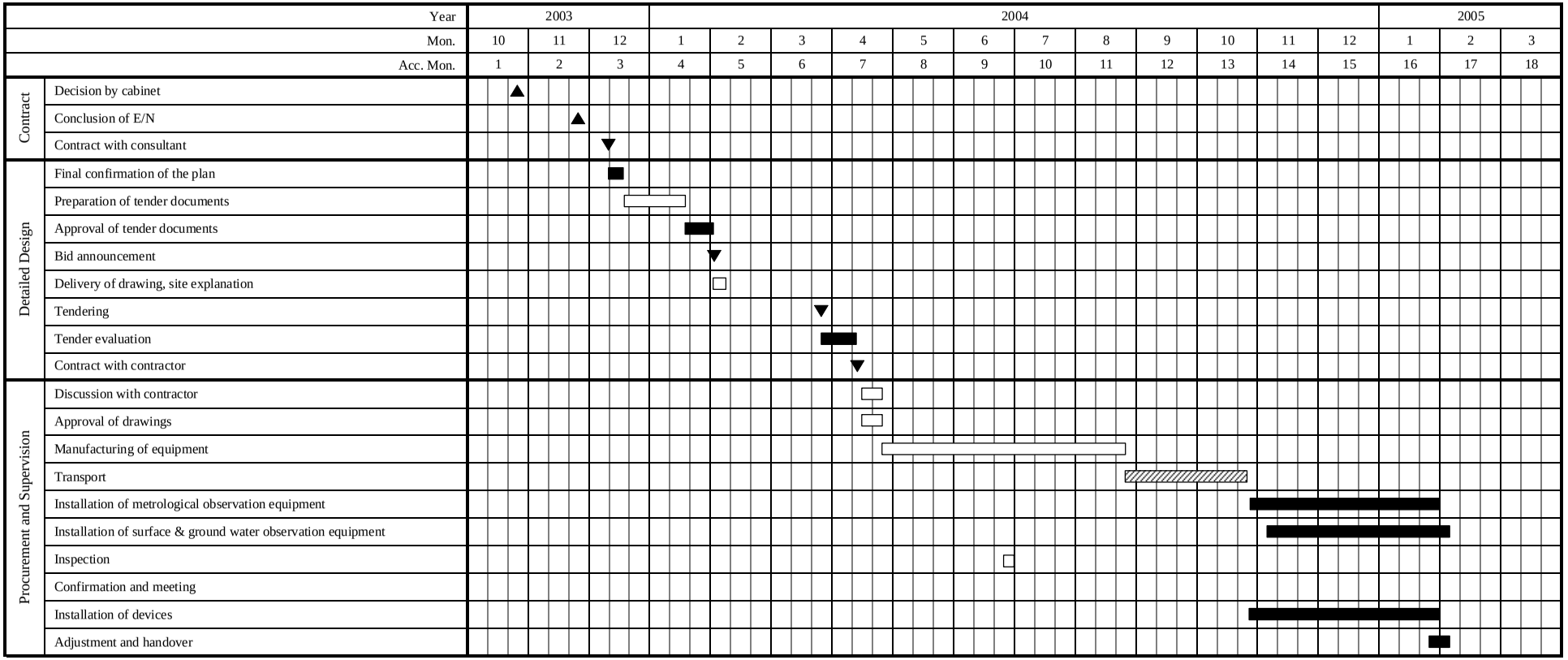
2-2-4-6 Quality Control Plan

This Project covers procurement and installation of equipment and materials. Therefore, the quality control to avoid the damage during transportation, inland transportation and storage until the installation is proposed.

2-2-4-7 Implementation Schedule

After conclusion of E/N, the Ministry of Irrigation will conclude the contract with a Japanese corporate consultant. The consultant will conduct the detailed design and prepare tender documents. After approval of the Japanese Government, the consultant, on behalf of the Ministry of Irrigation, will carry out the tendering to the Japanese enterers and consult with the contract with the Japanese contractor. Implementation schedule in draft for the Project is shown in Table 2-9.

Table 2-9 Implementation Schedule



2-3 Obligation of the Government of Syria

As shown in Table 2-8, Syrian side shall bear the costs and take necessary procedure for the exemption of taxes and custom clearance for the equipment and materials provided from Japanese side. Syrian side also shall coordinate with the related agencies, secure the security of the Japanese staff.

Syrian side shall undertake the following works for the installation of the equipment for the meteorological and hydrological stations.

① Land acquisition for the stations and keep access road to the stations
② Land grading of the sites for the installation and site clearing as required.
③ Other works

As to the riverbed fairing, parts of works conducted by Syrian side will be decided based on the discussions in June 2003 taking the budget into account. The Study Team and the WRIC staff also will discuss other sites after visiting the sites.

Procurement of each equipment and material is planned as shown in Table 2-10.

Table 2-10 Procurement of Equipment and Materials

Planned Equipment	Japan	Third Country	Syria	Remarks
I Meteorological Observation				
I-1 Automatic weather station	●	●		
I-2 Automatic rainfall	●	●		
I-3 Automatic evaporation station	●	●		
I-4 Snow measuring （sampler, scale）	●			
II Surface Water Observation				
II-1 Potable current meter	●			
II-2 Potable water level meter	●			
II-3 Automatic water level station	●	●		
II-4 Water quality	●	●		
III Groundwater Observation				
III-1 Manual water level	●			
III-2 Automatic water level station	●	●		
III-3 Automatic water level/ water quality station	●	●		
IV Related Equipment				
IV-1 Water sampler	●			
IV-2 Well logging	●	●		
IV-3 Field Vehicle	●			
V Riverbed Fairing	Note (1)		●	

Note (1): Japanese side will provide wire frame of gabion mattress for 4 sites

2-4 Project Operation and Maintenance Plan

2-4-1 Operation and Maintenance Organization

The operation and maintenance organization is shown in Figures 2-6, 2-7 and 2-8 as described in "2-2-4-2 Implementation Condition". The Water Resources Information Center (the Main Center) is neither operates nor maintains the equipment but it collects data obtained by both Barada-Awaj Basin and Coastal Basin Water Resources Information Centers. The Main Center plays the role of management of all the water resources information throughout the country. The Barada-Awaj Water Resources Information Center and the Coastal Basin Water Resources Information Center directly operate and manage the equipments, which will be installed by this Project.

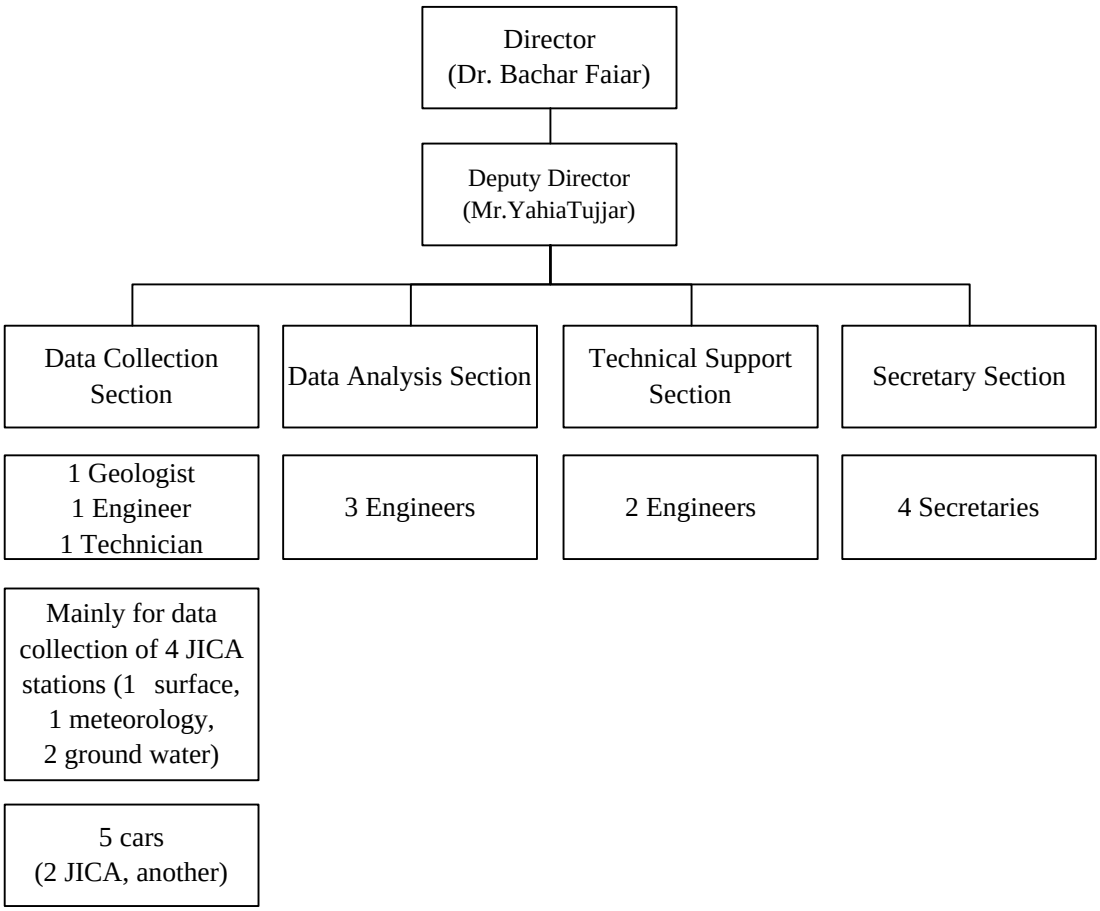


Figure 2-6 Organization of the WRIC

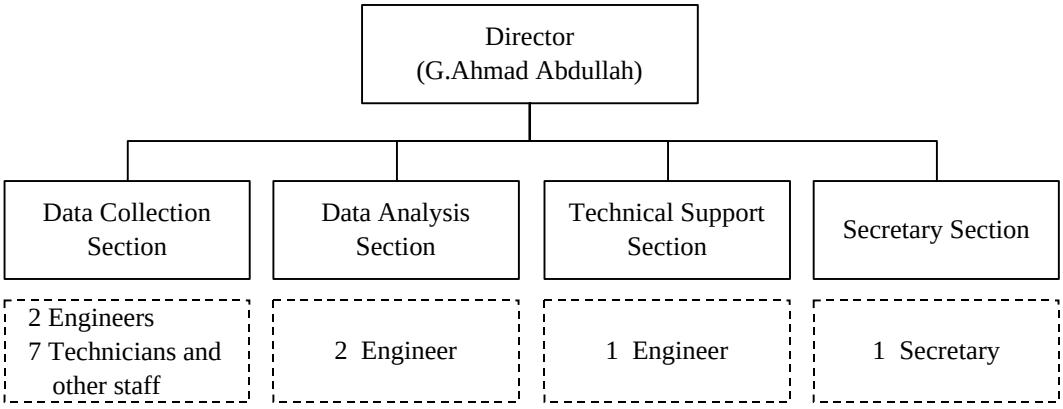


Figure 2-7 Organization of WRIC of GDBAB

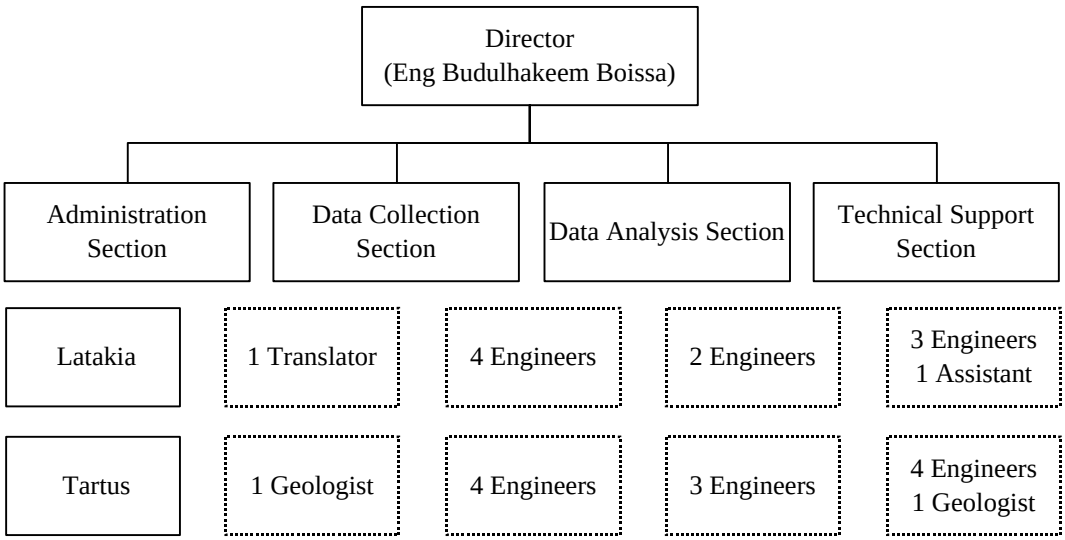


Figure 2-8 Organization of WRIC of GDCB

The responsibility of each center is as follows;

1) Water Resources Information Center (Main Center)

   The Main Center receives information collected and processed by the center of each basin and accumulate them with an unified format.

2) Barada-Awaj Basin Water Resources Information Center

   Barada-Awaj Basin Water Resources Information Center operates and maintain the equipments and obtain periodical hydrological observation data by the equipments. The data are processed and sent to the Barada-Awaj Basin Director as well as to the Main Center.

3) Coastal Basin Water Resources Information Center

Coastal Basin Water Resources Information Center operates and maintain the equipments and obtain periodical hydrological observation data by the equipments. The data are processed and sent to the Coastal Basin Director as well as to the Main Center.

Table 2-11 shows the number of new equipments installed by the Project.

Table 2-11 Proposed New Equipment by the Project

	Name	Number	Brada-Awaj Basin/ Main Center	Coastal Basin
1.	Automatic Weather Station	21	14	7
2.	Rain Gauge	24	14	10
3.	Snow Gauge and Snow Sampler	22	15	7
4.	Recording Evaporation Gauge	6	0	6
5.	Portable Current Meter	5	5	0
6.	Cable-Suspended Current Meter	4	0	4
7.	Automatic Water Level Recorder (surface water)	53	34	19
8.	Water Quality Analysis Device	18	10	8
9.	Portable Water Level Meter (ground water)	9	5	4
10.	Automatic Water Level Recorder (ground water)	144	110	34
11.	Automatic Water Quality Recorder (ground water)	46	33	13
12.	Water Sampler	9	5	4
13.	Well Logging Equipment	1	1	0
14.	Field Vehicles	5	3	2

The total number of equipments to be observed after the completion of the new equipments by the Project is shown in Table 2-12. As some of them are rehabilitation of the existing equipments, the total number is not the mathematical summation of the number of the existing equipments and the new equipments.

Based on the existing observation team organization and allocation of field vehicles, a new observation team organization plan and field vehicle plan were made as shown in Table 2-13.

Table 2-12 Number of Equipment (Existing and Newly Planned)

		Organization	Region	Meteorology	Rainfall	Surface water	Ground water	Total
A	Existing Equipment	GDBAB		9	0	151	178	338
		GDCB		7	0	76	94	177
			Latakia	4	0	40	32	76
			Tartus	3	0	36	62	101
		Total		16	0	227	272	515
B	Newly Planned Equipment by the Project	GDBAB		14	24	34	77	149
		GDCB		7	10	19	21	57
			Latakia	4	5	12	10	31
			Tartus	3	5	7	11	26
		Total		21	34	53	98	206
C	Rehabilitation of the Existing Equipment among B	GDBAB		0	0	14	77	91
		GDCB		1	0	2	21	23
			Latakia	1	0	2	10	12
			Tartus	0	0	0	11	11
		Total		1	0	16	98	115
D	Number of Equipment to be observed after the completion of the Project (A+B+C)	GDBAB		23	24	171	178	396
		GDCB		13	10	93	94	210
			Latakia	7	5	50	32	94
			Tartus	6	5	43	62	116
		Total		36	34	264	272	606

Table 2-13 Observation Team Plan

	Organization	Region	Meteorology	Rainfall	Surface water	Ground water	Total	No. of Team	No. of Equipment by one Team	No. of Vehicle
Existing Observation Team	GDBAB		9	0	151	178	338	6	56	6
	GDCB		7	0	76	94	177	6	30	6
		Latakia	4	0	40	32	76	3	25	3
		Tartus	3	0	36	62	101	3	34	3
	Total		16	0	227	272	515	12	43	12
Observation Team Plan after the Completion of the Project	GDBAB		23	24	171	178	396	8	50	8
	GDCB		13	10	93	94	210	8	26	8
		Latakia	7	5	50	32	94	4	24	4
		Tartus	6	5	43	62	116	4	29	4
	Total		36	34	264	272	606	16	38	16

Note: As the topography is hilly and the distance between the monitoring stations is relatively long in Coastal Basin, the number of the monitoring stations to be covered by one team of GDCB gets smaller than the number in GDBAB.

2-4-2 Allocation of Personnel

Based on Table 2-12, the allocation of personnel for observation work after the completion of the Project. Barada-Awaj Basin WRIC has to add newly two observation teams for the work. As the preparation of one observation team has been under progress by recruiting the staff members from their own directorate, one more monitoring team will be needed and three members should be newly employed for this purpose.

On the other hand, the Coastal Basin WRIC has to add two observation teams and six personnel should be newly employed. No new employment is necessary for the Main Center.

Table 2-14 Personnel Allocation Plan

	Present		Plan		Increment
	No. of Equipment	No. of Personnel	No. of Equipment	No. of Personnel	No. of Personnel
WRIC (Main Center)	0	12	0	12	0
GDBAB WRIC	338	13	377	24	11
GDCB WRIC	177	24	202	24	0
Total	515	49	579	60	11

2-5 Approximate Project Cost

Project Cost

The total cost estimated for Project implementation is approx. 674 million Japanese Yen. Each cost to be borne by Japan and Syria is described below, which is estimated on the basis of conditions mentioned in article (3). However, the estimated cost does not mean the grant cost to be described in the official Exchange of Notes between both governments.

(1) Estimated Costs Covered by Japanese Side

Provision of hydrological and meteorological observation equipment:
Approx. 607 million Yen

Table 2-15 Cost Covered by Japanese Side

Expense Item		Approximate Cost (million Yen)	
Facility	-	-	583
Equipment and Material	Surface water, groundwater, meteorological observation equipment, and related equipment	583	
Detailed Design・Supervision of Construction		24	

(2) Cost Covered by Syrian Side

Construction cost: Approx. 28.45 million SP (67 million yen)

(i) Construction cost for riverbed fairing: 14.76 million SP. (35 million Yen)
(ii) Site preparation, installation of fence, etc.: 13.69 million SP (32 million Yen)

(3) Condition for estimation

(i) Estimated on: May 31, 2003
(ii) Exchange rate: 1 US$ = 121.80 Yen
1 SP = 2.360 Yen
(iii) Execution period: Period for the detail design and provision of equipment and materials is as shown in implementation schedule.
(iv) Others: The project will be implemented in compliance with Japan's Grant Aid System

Operation and Maintenance Cost

The cost increment for the observation of the equipments is estimated as shown in Table 2-15 according to the increment of the number of personnel for observation operation. For the cost estimation, the cost for one employ is assumed as SP 15,250 /person/month.

Table 2-16 Increment of Observation Cost by the Project

	Increment of No. of Personnel	Unit Cost (SP/year)	
WRIC(Main Center)	0	183,000	0
GDBAB WRIC	11	183,000	2,013000
GDCB WRIC	0	183,000	0
Total	11		2,013,000

There are two alternative of maintenance method of equipment as follows;

(1) Each WRIC employs engineers and technicians for direct operation of maintenance of the equipment.
(2) Each WRIC makes unit cost contract with a maker or with a supplier for periodical maintenance of the equipment.

Discussions were made between the Study Team and the Syrian side on the above two alternatives and it was concluded that the alternative (1) was proposed. The reason is

that in Syria, the principle is direct maintenance of equipments by the in-house engineers and a contract with a maker or a supplier does not match with the principle.

Therefore, the WRIC personnel will do the maintenance of the equipment and the increment cost of personnel is included in the cost estimate of operation discussed above.

For the smooth maintenance operation, the cost for training of the WRIC personnel on operation and maintenance is included in the cost of equipment for the Project.

Necessary Operation and Maintenance (O&M) for the equipment supplied by the Project is to exchange battery for the data loggers, to repair pole and wire, to exchange engine oil for the vehicle, and so on. It is assumed that the O&M cost is equivalent to 2% of the equipment costs.

Based on the above assumption, the cost of O&M needed by the Syrian side starting from the 6th year after the completion of the Project is estimated as shown in Table 2-17.

Table 2-17 Operation and Maintenance Cost

	Equipment	Maintenance Cost (SP/year)
1.	Meteorological Equipment	1,003,000
2.	Surface Water Equipments	440,000
3.	Groundwater Equipments	2,365,000
4.	Related Equipments	256,000
	Total	4,046,000

CHAPTER 3

PROJECT EVALUATION AND RECOMMENDATION

CHAPTER 3 PROJECT EVALUATION AND RECOMMENDATION

3-1 Project Effect

(1) Direct Effects

The effects by the execution of the project are shown in Table 3-1. Items in parentheses are related to the on-going Project-type Cooperation Project.

Table 3-1 Project Effects

Present conditions and problems	Measures taken by this plan	Effects of the plan and improvements
1. Meteorological stations are not located properly	1. Provision of suitably distributed additional meteorological equipment	1. Regional and seasonal distribution of precipitation will be obtained
2. Surface water level observations are made, however, regional and time distribution of discharges are not clear yet.	2. Combination of automatic surface water level and discharge measurements.	2. Regional and seasonal distribution of the surface water will be obtained
3. Water level and water quality of the groundwater have not observed sufficiently, therefore, characteristics of pollution and movement of groundwater are unknown.	3. Continuous measurements of groundwater level and quality and use of well logging equipment	3. Characteristics of groundwater flow and pollution will become easier to understand
4. (Data related to water resources are not collected and processed; therefore, it is not possible to make studies for water resources management.)	4. (Data base under preparation by PTTC project. Time series and regional distribution of water resources will be obtained.)	4. (Studies for water resources management could be made)
5. (Shortage of engineers and other staff for operation/maintenance)	5. (Technology transfer by PTTC project is ongoing)	5. (Operation/maintenance of the meteorological and hydrological facilities could be made smoothly)

(2) Indirect Effect

The water resources are expected to be managed suitably, which will contribute to the sustainable development of the region and the whole country.

3-2 Recommendations

For getting the efficient execution of the Project and sustain its effects, the following is recommended to be undertaken by Syrian Side.

(1) Execution of the items to be undertaken by Syrian side

The items to be undertaken by Syrian side such as riverbed fairing, etc shall be executed.

(2) For the effective use of the equipment to be provided by the Project, the staff and organizations required for meteorological and hydrological observation shall be prepared and established. For smooth implementation of the observation system, the annual budget required for operation and maintenance shall be prepared.