



# WATER SUPPLY AND WASTEWATER SYSTEMS MASTER PLAN FOR THE BEKAA WATER ESTABLISHMENT

**TOR FOR IRRIGATION  
MASTER PLAN**



January 2015

# **Terms of Reference Bekaa Water Establishment Irrigation Water Master Plan Report**

## **1. General Objective**

The general objective for the Irrigation Water Master Plan is to complete and complement the effort invested in developing the Water and Wastewater Master Plan for the Bekaa Water Establishment under the United States Agency for International Development funded “Lebanon Water and Wastewater Sector Support” program. The Irrigation Water Master Plan will describe a set of activities framed within the general principles of sustainable development and the priorities set in the draft “Water Code” of Lebanon to empower the Bekaa Water Establishment and allow it to fulfill its mission as per Law 221/2000.

It will identify and set priorities for capital investments and administrative developments for the period 2015-2035 and beyond leading the Bekaa Water Establishment to take effective control of the existing irrigation systems in its service area. In doing this, Bekaa Water Establishment intends to develop and provide reliable irrigation water supply, where possible and feasible, to meet the needs of the farmers, growers, agro-industries and others in conformity with its statutes, its approved Water and Wastewater Master Plan and the National Strategies for Water and Agriculture.

The General Objectives of the Irrigation Water Master Plan can be summarized as:

- Complete the survey of publicly owned irrigation related assets to cover all publicly owned and developed irrigation schemes and projects in the Bekaa, excluding those under operation by the Litani River Authority.
- Develop irrigation water needs projections over the twenty year planning period and assess local water balances to determine potential deficiencies of supply and needs for improvements.
- Identify, estimate and set priorities for capital investments for the period 2015-2035.
- Propose a strategy for timely take-over of irrigation schemes by the Bekaa Water Establishment, taking into consideration operations and maintenance costs, and the integration of potable and irrigation water tariffs.
- Define general strategy elements for water management in the Bekaa that integrate potable water supply, irrigation and treated wastewater effluent reuse.
- Investigate and recommend alternatives for irrigation water sector management strategies, including the devolution of responsibilities to Water Users Associations in existence or that would need to be created.

## 2. List of Acronyms

BWE	Bekaa Water Establishment
CDR	Council for Development and Reconstruction
DAI	Development Alternatives, Inc.
GIS	Geographic Information System
GPS	Geographic Positioning System
IWMP	Irrigation Water Master Plan
IWRM	Integrated Water Resources Management
LARI	Lebanese Agricultural Research Institute
LRA	Litani River Authority
LWWSS	Lebanon Water and Wastewater Sector Support
MEW	Ministry of Energy and Water
MOA	Ministry of Agriculture
NWSS	National Water Sector Strategy
USAID	United States Agency for International Development

## 3. Background

The Bekaa Water Establishment (BWE), with the funding assistance of the United States Agency for International Development, has been undertaking a number of planning activities to set the course for capital investment within its service areas to improve the provision of water supply, wastewater, and irrigation services, as mandated in the enabling legislation for BWE. The purpose of this Terms of Reference is to continue this process of capital planning to detail an Irrigation Water Master Plan to complement similar Master Plans that have been prepared for Water Supply and Wastewater.

### 3.1 Irrigation Service Area under the Jurisdiction of BWE

Within the geographic area of the Bekaa Valley, BWE shares the irrigation responsibility with the Litan River Authority, with the irrigation area served by BWE being defined as follows:

*The BWE irrigation service area contains the upper part of the Litani basin that falls, in Rachaiya to the south-east in the Anti-Lebanon, and in Ham-Maaraboun and Tfail to the southeast of Baalbeck and across the Anti-Lebanon.*

*Decree 14522, dated 16 May 1970, defined the service area of the LRA in the South Bekaa as that area extending from the dam of Qaraoun in the south up until the Beirut-Damascus road north and between the course of the Litani River and the irrigation channel at altitude 900m north until Riyaq. Decree 9631 dated 13 December 1996 extended the geographic jurisdiction of the LRA to the remaining parts of the Litani basin.*

*It is important to note that the LRA operates and maintains only those irrigation networks in the south Bekaa that were developed as a result of the construction of the Qaraoun dam and are supplied with water pumped from the lake along the so called Canal 900, running at elevation 900m.*

However, under the Wastewater Management Strategy for Lebanon, approved by the Council of Ministers, all wastewater treatment facilities that discharge treated effluent inland must provide that the effluent is used as irrigation water. Consequently, within the irrigation service area of the Litany River Authority, BWE must work in total cooperation with the Litany River Authority for the efficient and effective use of this treated effluent.

### **3.2 Agriculture in the Bekaa and Baalbeck-Hermel**

The Baalbeck-Hermel Mohafazat has an estimated total useful agricultural area of 57,265 hectares out of which 31,700 are irrigated; with 48% of irrigated lands are fully irrigated and the remaining 52% partially irrigated. Of the irrigated areas in Baalbeck-Hermel, 57% of them use modern sprinkler or drip irrigation technologies, these areas however correspond more frequently to large farming properties that rely on private wells for irrigation water rather than to the farming properties that rely on public irrigation networks.

The average irrigated area per farm in the Bekaa and Baalbeck-Hermel is 3.4 hectares, the largest average in Lebanon. It is also important to note the presence of a few large dairy farms with their associated dairy industries. Surface waters contribute an estimated 40-45% of all the waters needed for irrigation with the rest of the water being obtained from groundwater sources through private wells, the number of which is estimated in the thousands.

The lower reaches of the Caza of Rachaiya fall into the Litani basin, while the rest of it falls on the westward side of Anti Lebanon and Mount Hermon reaching all the way to the top of the mountains. The total useful agricultural area in Rachaiya is about 5,900 hectares out of which 16% are irrigated. No large irrigation schemes have been developed in Rachaiya due to the nature of the terrain and the limited availability of water resources.

### **3.3 Existing Irrigation Systems Falling under BWE Jurisdiction**

Public irrigation networks or schemes in Lebanon have been historically managed by regional water authorities or local water committees all of which were consolidated in the four regional water establishments by Law 221/2000. These are traditional, low efficiency irrigation schemes originating mostly at spring intakes or small water courses, and consist of open channels, which are mostly concrete for the main lines and a mix of concrete and dirt in some of the smaller branches. Some pipe systems have also been installed.

The list of the irrigation schemes that fall under the BWE, as identified in the World Bank Policy Note on Irrigation (Report No. 28766-LE, 2003) is presented in Table 1.

**TABLE 1  
IRRIGATION SCHEMES UNDER BWE**

<b>Code</b>	<b>Scheme name</b>	<b>Equipped area (ha)</b>	<b>Net irrigated area (ha)</b>
1	Hermel High land Farms (JurdHermel)	1,100	990
2	Merjhine	160	140
3	Hermel Watershed	650	590
4	Assi Plain	400	360
5	El Qaa	3,000	2,700
6	OyounTagtaq	100	90
7	RasBaalbeck	300	270
8	Laboue	2,080	1,870
9	Chaat and Surroundings	800	720
10	Younine	100	90
11	OyounOrghosh - Barqa-Nabha and Surroundings	400	360
12	Yammoune	5,600	5,040
13	WadiNahle and Surroundings	150	140
14	laat Plain	270	240
15	Baalbeck Plain-Douris and Surroundings	2,000	1,800
16	Maaraboun and Ham	120	110
	<b>Total</b>	<b>17,230</b>	<b>15,510</b>

The information available related to existing irrigation water systems under the BWE was collected from the BWE and the MEW, and digitized for integration into the BWE GIS database as a separate layer.

Table 2 presents the systems entered in the GIS database with their characteristics, noting that 88% of all primary and secondary networks entered are concrete channels, 10% are pipes, and only 2% are earthen channels. Yammoune and Laboue are by far the largest two with more than a 100km of length each for a total length of 291km of identified networks. All the entries in Table 2 should have appeared in Table 1. The obvious discrepancy between the two tables may be due to the identification made of those schemes by different informants. It is possible that some of the smaller networks may have been included by the WB in the general geographic location of larger schemes and hence do not appear independently in the GIS database, while other smaller networks have been missed or have not been included for lack of information.

**TABLE 2**  
**IRRIGATION SYSTEMS IN BWE GIS DATABASE**

Caza	Name of Irrigation Scheme	Type				Total Length (m)
		Primary Concrete Channel (m)	Secondary Concrete Channel (m)	Earth Channel Length (m)	Pipe Length (m)	
Baalbeck	Yammoune <sup>1</sup>	58,887	30,282	---	19,416	108,585
	Baalbeck <sup>1</sup>	15,008	15,384	---	---	30,392
	Laboue <sup>1</sup>	33,178	77,480	2,116	---	112,773
	Nabi Osman <sup>2</sup>	190	---	---	---	190
	El Ain <sup>2</sup>	675	---	211	---	886
	Fekeh <sup>2</sup>	2,252	---	---	---	2,252
	Ras Baalbeck <sup>2</sup>	1,359	---	---	---	1,359
	Qaa (El) <sup>1</sup>	---	32,500	---	---	32,500
	Ras El Assi <sup>3</sup>	---	---	---	8,984	8,984
Hermel	Merjhine <sup>1</sup>	7,348	---	---	---	7,348
	Hermel <sup>1</sup>	11,633	---	2,831	---	14,464
	Qasr <sup>2</sup>	2,507	---	1,612	---	4,119
<b>Total</b>		<b>133,037</b>	<b>155,646</b>	<b>6,770</b>	<b>28,400</b>	<b>323,852</b>

<sup>1</sup> Scheme identified in WB Report No. 28766-LE, 2003

<sup>2</sup> Smaller schemes not identified in WB Report No. 28766-LE, 2003 or lumped by error in larger neighboring ones

<sup>3</sup> New scheme under development by the MEW under the Assi Dam Phase I project

Reference should be made to a map showing the location of the identified public irrigation schemes under the jurisdiction of the BWE as contained in the Irrigation Water Assessment Report, as well as the details of those digitized in the GIS database. Main networks are shown for those systems for which plans were found. The remaining systems are identified by location only. Detailed plans for many systems as well as secondary and tertiary parts of other systems are still missing and may need to be completed through a topographical surveying campaign.

In addition to those identified sizable public irrigation schemes, much smaller irrigation schemes, or small networks of canals serving multiple beneficiaries, may exist across the BWE jurisdiction area, but have not been accounted for as they may historically have been under the responsibility of a local municipality and not a water committee or regional authority.

## **4. Scope of Work**

### **Task 1: Conduct Initial Investigations and Schedule Review**

- 1.1 Review Irrigation Assessment Report and reference documents noted in that Report.
- 1.2 Conduct preliminary discussions with the Ministry of Energy and Water and the Ministry of Agriculture to assess the general views of the needs to be addressed in the development of the Master Plan
- 1.3 Conduct preliminary discussions with selected, current users of the irrigation systems under the jurisdiction of the BWE to understand their concerns and expectations from the Master Plan process.
- 1.4 Consider the Scope of Work, in light of the preliminary information gained above and the Project Schedule and prepare an Inception Report with redefines and clarifies the detailed actions to be taken and schedule to be followed to fulfill the Project deliverables.
- 1.5 Liaise through the office of the BWE Chairman-Director General with institutional stakeholders to establish a Steering Committee chaired by the seated Minister of MEW and vice-chaired by the BWE Chairman-Director General, and consisting of the relevant senior officials from the MEW, the MOA, the LRA, the Lebanese Agricultural Research Institute (LARI), and CDR.

### **Task 2: Update and Complete Irrigation Assets Survey**

- 2.1 Complete the survey of publicly owned irrigation related assets, to the degree possible through digital restitution of aerial or satellite photogrammetry to cover all publicly owned and developed irrigation schemes and projects in the service area of the BWE, excluding those under operation by the LRA. Verify and confirm the digital restitution work through point GPS field measurements at spring catchment starting points, major branching points, start of lines, and end of networks.
- 2.2 Coordinate with BWE, MEW, local municipalities, and water committees for the collection of relevant information.
- 2.3 Update the GIS database of BWE irrigation assets based on the complete survey.

### **Task 3: Review and Update Existing Irrigation Water Systems Information**

- 3.1 Starting with the Irrigation Services Assessment Report complement, update, and review all existing pertinent information, studies, data, and planned projects at the different governmental institutions concerned with irrigation namely the Ministry of Energy and Water, the Ministry of Agriculture, and the Council for Development and Reconstruction. Liaise and coordinate with the other stakeholders such as the regional chamber of Commerce, Industry and Agriculture, the Association for Lebanese Industrialists, the Syndicate for Agro-food industries, the Directorate General for Urban

Planning, and the specific farmers and growers associations such as the National Wine Institute, and any existing Water Users Associations.

- 3.2 Meet with international donors and agencies currently working on irrigation and agriculture development in the Bekaa and collect data on ongoing and planned projects.
- 3.3 Review and update available data and maps for soils, land use, agriculture, irrigated areas, hydro-geology, and hydrographic studies for the Bekaa BWE service area in coordination with the MOA and LARI.
- 3.4 Collect and update all available data on the current management structure of schemes (under direct BWE supervision, local water committee, or municipality), their current operating costs, tariffs paid, irrigation methods, crops, and customers or beneficiaries databases.
- 3.5 In coordination with the MEW, review updated plans for the study and construction of the dams and lakes, and the status of the proposed irrigation perimeters that will result.

#### **Task 4: Calculate Irrigation Water Demand and Water Balances**

- 4.1 Collect and analyze existing data on the irrigation practices and water usage and consumption per type of soil and culture.
- 4.2 Using the relevant elements of the agricultural strategy of the MOA and the projected growth in agricultural production and irrigated areas, and the projected changes in land use, develop low, medium, and high irrigation water demand scenarios for the 2035 horizon; taking into account the improvements in irrigation techniques and the possible shifts in types of crops.
- 4.3 Calculate local water demand on the basis of the naturally and geographically separate irrigable perimeters and the different water scenarios for water demand.
- 4.4 Calculate local water balance on the basis of the separate irrigable perimeters and project local water deficits taking into account the available waters from surface waters springs subject to the needs of potable water, the available water from rivers, the volume of effluent from projected wastewater treatment plants, and the storage volumes in the projected dams and lakes construction.

#### **Task 5: Recommend Specific Improvements, Take Over Action Plans and Estimate Capital Costs**

- 5.1 Develop recommended improvements to the existing irrigation water systems in the BWE service area that are consistent with the approved Water and Wastewater Master Plans, the NWSS and those relevant elements of the National Strategy for Agriculture.
- 5.2 Develop alternatives for a take-over plan for the BWE to integrate the irrigation systems that fall under its jurisdiction but that are still being operated by local water committees or municipalities by proposing new specific improvements against hand



over by the current operators or by developing Water Users Associations to partner in operations and maintenance. Water Supply and Waste water Systems Master Plan (BWE Region) TOR for Irrigation Water Master Plan

- 5.3 Propose new capital investments to develop new irrigated schemes in the BWE service area that are consistent with the approved Water and Wastewater Master Plans, the NWSS and those relevant elements of the National Strategy for Agriculture.
- 5.4 Present the recommendations to the Steering Committee for review and final approval.
- 5.5 Prepare a capital investment plan that presents separately improvements in the form of rehabilitation and replacement to existing irrigation systems, and new capital improvements in the form of extension of existing irrigation systems or the construction of new ones.
- 5.6 Develop cost estimates for the operation and maintenance of the irrigation water systems and for the deployment of system wide metering including production, zone, and consumer metering.
- 5.7 Prepare a timetable and set priorities for the implementation of the approved proposed improvements and the capital outlay needed for these improvements in order to integrate them into the future capital plan and business plans of the BWE over the planning period 2015-2035.
- 5.8 Conduct a Stakeholders Meeting based on the Draft Report developed under this Task, before finalizing the Report.

#### **Task 6: Develop and Assess Strategic Alternatives for BWE Irrigation Water Sector Management**

- 6.1 Develop strategic management alternatives for the irrigation water sector in the Bekaataking into account the priority given to the supply of potable water, the economic cost of water, and the sustainability of current irrigation practices that rely heavily on the unregulated use of groundwater pumped from illegal wells.
- 6.2 Identify and set priorities for the concurrent capital investments by the principal stakeholders (BWE, MEW, CDR, MOA) for the period 2015-2035 in order to meet their strategic objectives.
- 6.3 Present the recommendations to the Steering Committee for review and final approval.

#### **Task 7: Prepare Irrigation Water Master Plan and Conduct Reviews**

- 7.1 Prepare Draft Irrigation Water Master Plan Report integrating Tasks above.
- 7.2 Conduct Stakeholders meeting to present Report.
- 7.3 Finalize Irrigation Water Master Plan Report.

## 5. Main Tasks, Deliverables and Time Schedule

No.	Task	Deliverable	Time from Start
1	Conduct Initial Investigations and Schedule Review	Inception Report	2 Months
2	Update and Complete Irrigation Assets Survey	Updated GIS Data Base	4Months
3	Review and Update Existing Irrigation Water Systems Information	Report on Existing Systems and the Available Performance Data	6 Months
4	Calculate Irrigation Water Demand and Water Balances	Report on Water Demand Projections and Water Balances	8Months
5	Develop Specific Improvements, Take Over Action Plans and Estimate Capital Investment Costs	Report on Improvements, Action Plans and Capital Investment Costs	11Months
6	Develop Strategic Alternatives for Irrigation water sector management	Strategic Alternatives for Irrigation Water Management Report	13Months
7	Prepare Irrigation Water Master Plan Report and Conduct Reviews	Final Irrigation Water Master Plan Report	15Months

## 6. Key Project Staff

Position/Expertise	Degree	Years of Experience
Water Resources Engineer – Project Manager	Master in Science	15
Irrigation Engineer	Master in Science	10
Agricultural Engineer	Bachelor in Science	10
Agronomist	Bachelor in Science	10