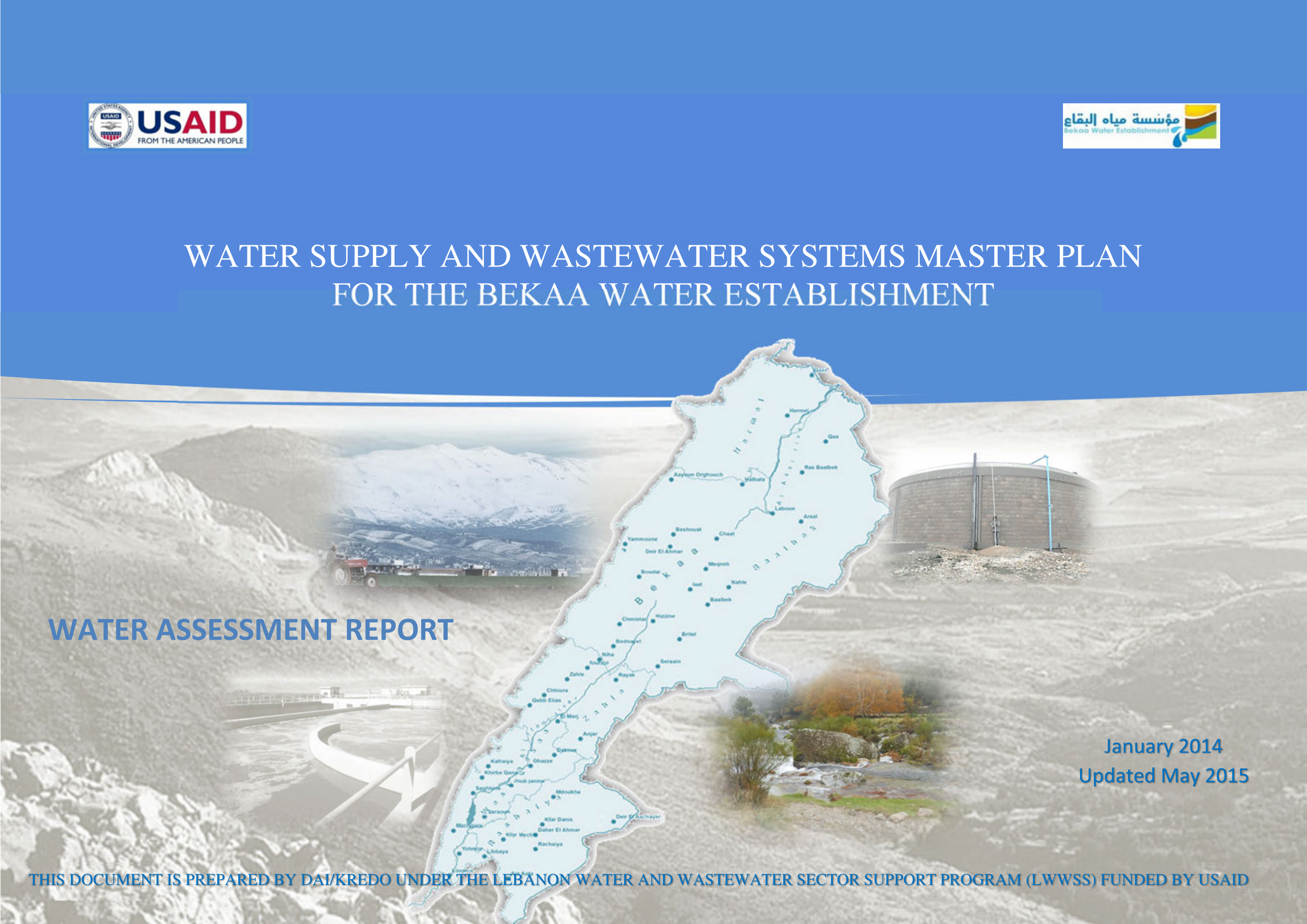
WATER SUPPLY AND WASTEWATER SYSTEMS MASTER PLAN FOR THE BEKAA WATER ESTABLISHMENT



WATER ASSESSMENT REPORT

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THIS DOCUMENT IS PREPARED BY DAI/KREDO UNDER THE LEBANON WATER AND WASTEWATER SECTOR SUPPORT PROGRAM (LWWSS) FUNDED BY USAID

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BWE	BEKAA WATER ESTABLISHMENT
CDR	COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION
DAI	DEVELOPMENT ALTERNATIVES, INC.
GIS	GEOGRAPHIC INFORMATION SYSTEM
K&A	KHATIB & ALAMI
LRA	LITANI RIVER AUTHORITY
LWWSS	LEBANON WATER AND WASTEWATER SECTOR SUPPORT
MEW	MINISTRY OF ENERGY AND WATER
RELK&P	RAFIK EL-KHOURY & PARTNERS
USAID	UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

1 INTRODUCTION

1.1 Background

On December 1st, 2012 Kredo has been commissioned by DAI to carry out the project entitled "Development of a Water Supply and Wastewater Systems Master Plan Within The Service Area of the Bekaa Water Establishment" as part of the USAID – Lebanon water wastewater sector support program (LWWSS). The scope of the current study is to establish water supply and wastewater master plans in order to support the Bekaa water establishment (BWE) decision-makers in the preparation of a rational infrastructure development and capital investment plan for water supply, water distribution, wastewater collection and wastewater treatment systems, as well as elements of an irrigation system. More specifically, the water component encompasses the following activities:

- Collect existing studies concerning water facilities and water networks as well as any existing master plans. Focus will be on recent and relevant studies.
- Collect information concerning water facilities and water networks already executed.
- Determine current and future water needs based on population projections for the year 2035. The projected volumes of water for every village and by region shall be calculated.
- Make recommendations for improvements to the water networks and facilities according with the national water sector strategy and the BWE 2012-2016 business plan, and present these recommendations in a schedule of Capex and Opex along with their timing.
- Evaluate funding mechanisms for all recommended actions.

This report presents the results of the data collection campaign regarding the existing and planned water networks as well as the existing water facilities in the Bekaa. It is divided in 8 chapters. Chapter 1 gives a general overview of the activities undertaken in order to arrive at the description of the current status of the water sector in the Bekaa. Chapters 2, 3, 4, 5, and 6 present in details the results of the data collection campaign regarding water networks and facilities for the cazas of Hermel, Baalbeck, Zahle, West Bekaa, and Rachaiya, respectively, chapter 7 summarizes the findings of this campaign and gives general comments and recommendations concerning the existing situation and the future, and chapter 8 presents the next activities to be undertaken.

1.2 Water Networks

The status of the water networks in the Bekaa proved extremely difficult to assess. The information is fragmented and incomplete. A massive effort was deployed to gather bits and pieces of information and transform them into a coherent picture. Some of the data was obtained in hardcopy format while some was obtained in AutoCAD format. Both had to be transformed into a GIS format.

In view of the difficulty encountered in obtaining the required information upfront, a data collection campaign was conducted with the municipalities, noting that the localities that do not form a municipality are usually small in terms of population. This campaign comprised two components: a written questionnaire and a phone interview. Questions focused on the water supply method used by the village (spring, well, water source), as well as the status of the existing water network. Phone calls were placed with the municipalities that did not return the questionnaire or that returned it with partial information. These were also requested to provide a copy of their water network map, if available. The results of this data collection campaign in each caza are summarized in a table included in each of chapters 2 to 6. It can be noticed from the entries in these tables that most municipalities were not cooperative, and virtually none provided any maps. Some municipalities gave as much information as available to them; others gave partial or sketchy information, while the rest did not answer the questions either on the phone or in the questionnaire. At the end, the network layouts for both the municipalities and other localities were gathered from other sources but the qualitative description given by the municipalities proved useful. Aside from the municipalities, the localities for which no network could be found in all the documents collected were assumed not to have any.

Chapters 2 to 6 include plans that present the information gathered from municipalities, the CDR, the BWE, the mew, as well as various contractors, and other sources. This information includes the layout of existing networks (old or new) as well as the layout of the planned networks which are studied (mostly by the CDR) but not executed yet.

1.3 Water Facilities

The water facilities in the Bekaa include wells, springs, ground reservoirs, elevated tanks, pumping stations, chlorination stations and water treatment plants.

The information regarding the water facilities in the Bekaa is conflicting. Different official sources list different information for the same facility (reservoir volume, well depth, facility's elevation, etc.). Even different BWE sources report different values. Site visits were conducted at a number of facilities by a Kredo specialist, sometimes accompanied by a BWE staff member, but in some cases these visits resulted in yet another set of information (because of different estimates or observations). Hence, for each facility a comparison between all the different available information was made and one set of data was selected based on various criteria, such as the reliability of the source, visual information from available photos, double checking with BWE staff, and analysis of all available parameters.

Particular difficulty was encountered in gathering data for the springs. In fact there is a notorious lack of information in Lebanon regarding the flow of water courses and springs which at best have been measured only sporadically and partially to date. Some historical data exists for a handful of water sources but it falls very short of providing the statistical significance needed to make reliable estimates of water flows. There is a pressing need to set up a modern hydrometric network for measuring all hydrological parameters related to precipitation, river flows, soil infiltration and groundwater recharge in all of Lebanon, including the Bekaa, in order to be able to conduct a comprehensive water balance model for each region. Unfortunately for the purposes of the present study water availability estimates will have to rely on very limited and fragmented recordings of water flows. The data gathered to date is listed in each chapter for the springs located in the corresponding caza, but efforts are still ongoing to gather more information. The final results of the data gathering campaign will appear in the future master plan report.

Table 1-1 below lists the number of existing facilities of each type per caza, as compiled from the various sources. It is important to note that the number of wells includes only public wells (BWE and municipal wells), while the number of private wells (legal and illegal wells) in the Bekaa is thought to exceed 10,000.

TABLE 1-1: NUMBERS OF FACILITIES IN EACH CAZA.

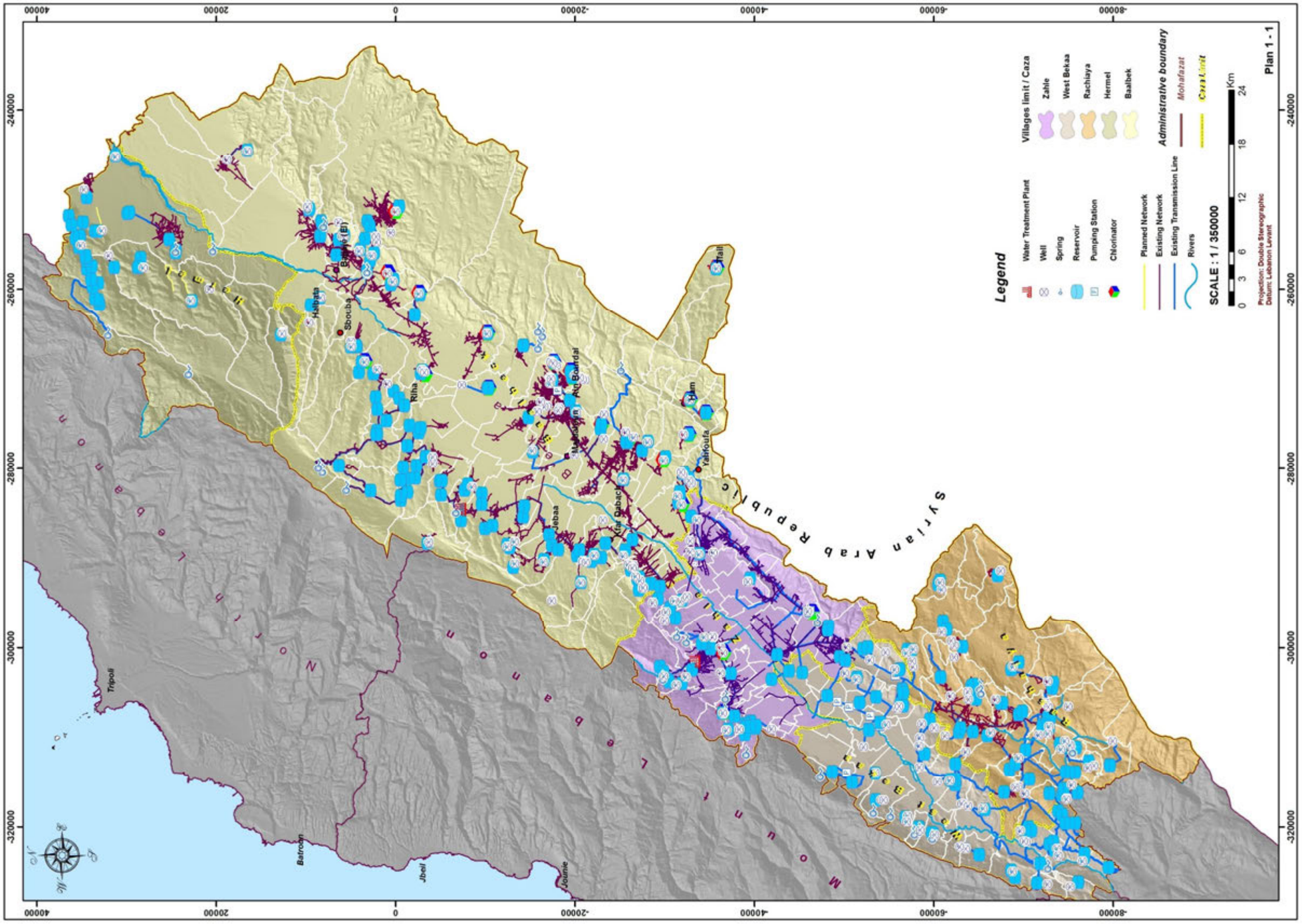
Caza	Wells	Springs	Water Treatment Plants	Chlorination Units	Pumping Stations	Reservoirs	Elevated Tanks
Zahle	46	14	1	3	6	41	4
Baalbeck	98	17	1	15	5	131	6
West Bekaa	39	17	0	2	6	52	10
Hermel	12	2	0	0	2	38	2
Rachaiya	43	16	0	0	7	44	10
Total	**238**	**66**	**2**	**20**	**25**	**306**	**32**

Each facility was given a code composed of 4 characters: the first letter refers to the caza (B for Baalbeck, Z for Zahle, H for Hermel, W for West Bekaa, and R for Rachaiya), the following number refers to the locality with the localities arranged by alphabetical order, then the letter refers to the facility (R for reservoir, W for well, S for spring, PS for pumping station, ET for elevated tank, and CL for chlorination), and the last number refers to the number of each type of facility in that locality. So for example R11R2 refers to the second reservoir in the eleventh village (alphabetically) in Rachaiya.

In chapters 2 to 6, the schematics of the existing water systems linking the facilities is presented for each locality and for the major springs. In order to come up with these schematics, the relevant information for each community gathered from the various sources had to be painstakingly analyzed, evaluated, and screened. Still, in some instances, as can be seen on some sheets, the connections between the various facilities could not be figured out due to the lack of reliable data.

In addition to the layout, an assessment of the facilities current status and recommendations for improvements are given. Pictures of the facilities are also included. This comprehensive assessment has been conducted based on site visits, meetings with BWE staff, and available information from previous studies. However, some facilities are impossible to accurately assess within the scope of work of this study as their evaluation requires close monitoring over an extended period of time (such as wells, chlorination units, etc.).

Plan 1-1 shows the location of the existing facilities for the Bekaa as a whole.



PLAN 1-1: WATER SYSTEMS FOR THE BEKAA

2 HERMEL CAZA

2.1 Water networks

The data collection campaign carried over the course of several months included various undertakings, among which the survey conducted with municipalities through the questionnaires and the phone interview. Table 2-1 summarizes the results of this survey.

There are two existing but very old networks in use in the caza of Hermel, one in the city of Hermel and the other in the village of Qasr. Networks are proposed for the villages of Wadi el Ratl, Ouadi Et Tourkman, Mrah el Mougher, Qasr, Sahet el Mai, Qanafez and Fissane. Except for Qasr and Fissane, each of these networks consists in one main pipe only, however the villages are small. As for the city of Hermel, the municipality declared that a new network is being studied currently however the design could not be obtained.

Figures 2-1 and 2-2 show respectively the percentages of population and of villages in the caza of Hermel served by existing or planned water networks. Form these pie charts it is noted that 22 % of the Hermel population, corresponding to 73 % of the caza villages is not served by any existing or planned networks.

Plans 2-1 and 2-2 show the layout of the existing water networks for the caza of Hermel as a whole and the city of Hermel, respectively.

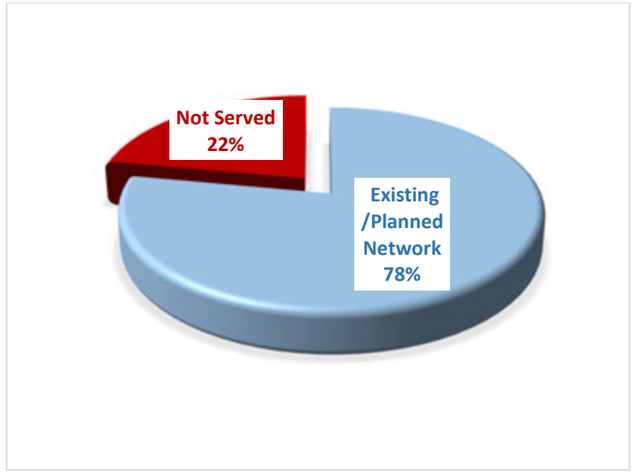


FIGURE 2-1: PERCENTAGE OF POPULATION SERVED BY WATER NETWORKS IN HERMEL CAZA

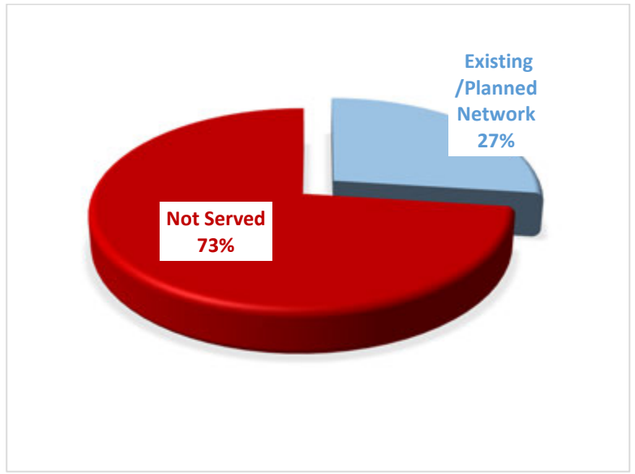
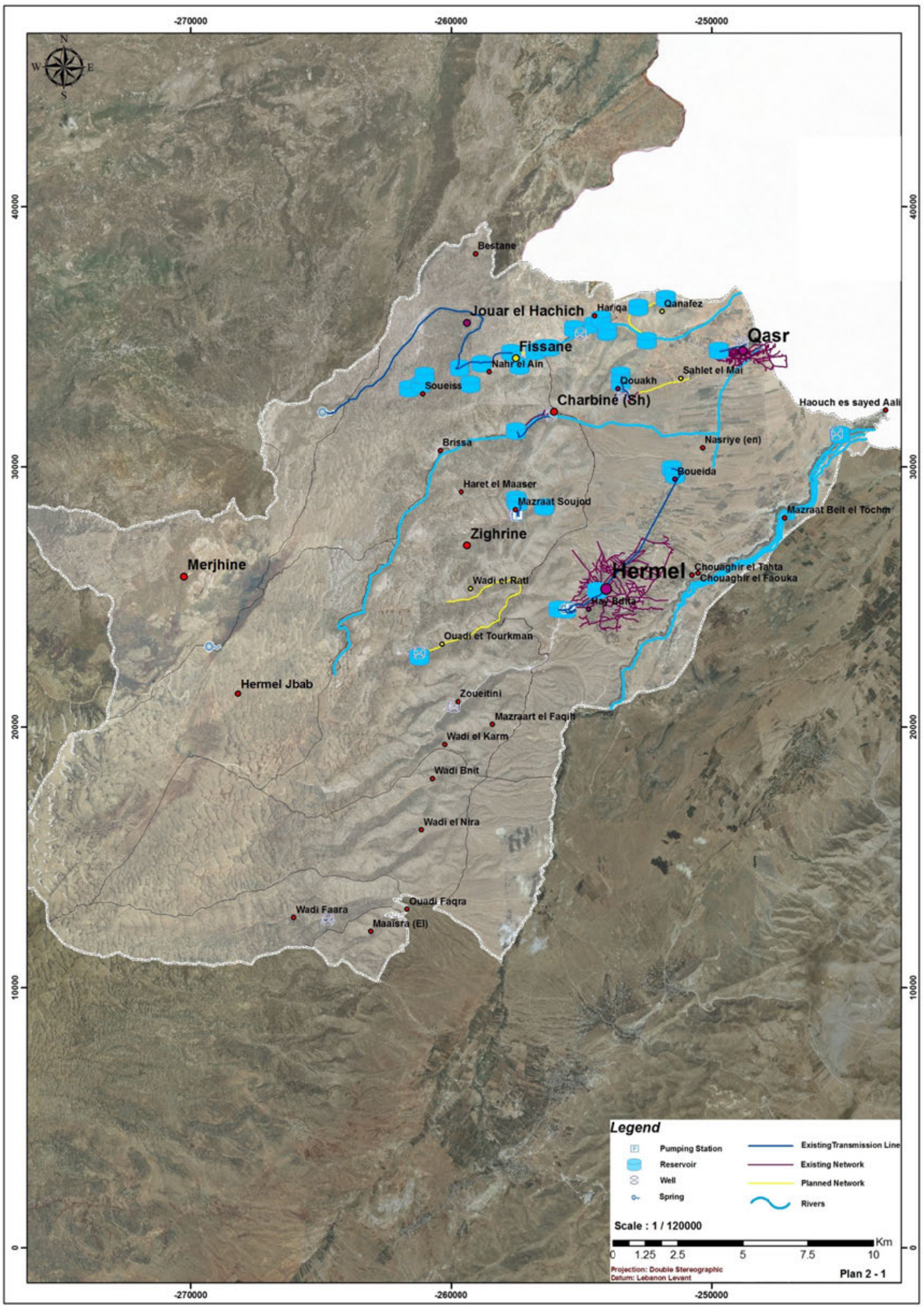


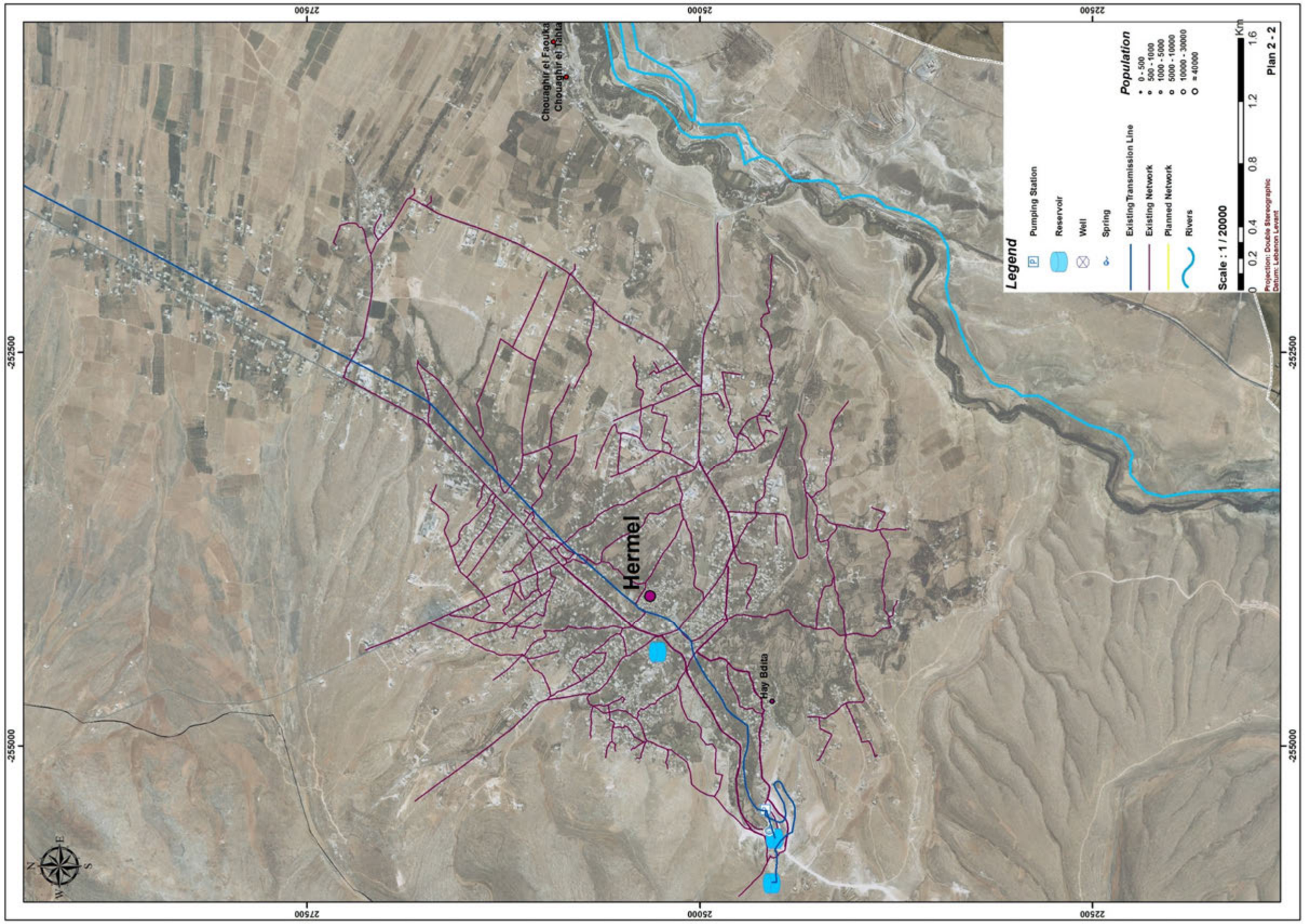
FIGURE 2-2: PERCENTAGE OF VILLAGES SERVED BY WATER NETWORKS IN HERMEL CAZA

TABLE 2-1: WATER NETWORK STATUS IN CAZA OF HERMEL

Caza		Village Name	Information From Questionnaire/Phone Interview						Response Of Municipality To Phone Request For Water Maps	Network Maps Availability Status
			Wells	Spring	Water Network	Water Source	Network Construction Date (Year)	Status Of Water Network According To Municipality		
Hermel	1	Jouar el hachich (el haref - el zakiyah - el hawchariya - sahlat el maa - qanafez)	No answer	No answer	Yes	No answer	50 years old	* Network is unused (bad condition)	Not available at municipality	Not obtained
	2	Chouaghir el faouka - and el tahta	No answer	No answer	No answer	No answer	No answer	No answer	Municipality didn't answer our phone calls	Not obtained
	3	Hermel	No answer	No answer	Yes	No answer	No answer	* Network is old * A new network was designed but not yet installed in all the town	Told us to contact ministry of energy and water	Planned design not obtained obtained - existing network



PLAN 2-1: WATER SYSTEMS FOR CAZA OF HERMEL



PLAN 2-2: WATER SYSTEMS FOR CAZA OF HERMEL - HERMEL CITY

2.2 Hermel water facilities

In the caza of Hermel the layout of the water facilities, along with their assessment are included for 17 localities. The other localities do not have any BWE facilities. Some of these villages are supplied with water from another village (in which case this will be shown on the schematics of that village), while the others rely on private wells and/or non-serviced sources or on privately acquired water. As can be seen on some of the layouts, some facilities are not connected to the system because no information could be obtained about their position relative to the other facilities.

For the villages of Jouar El Hachich, Ouadi Et Tourkman, and Wadi El Ratl where no BWE facilities exist, some information was gathered orally from local authorities about some planned facilities. These are shown in two layouts included in this section. However, as no coordinates were given for these facilities, no codes were given and they were not located on the map.

In Hermel, 87% of the reservoirs (ground reservoirs and elevated tanks) are very small in size (with a capacity of less than 100 m^3), while 3 % only are large with a capacity of 2000 m^3 or more (figure 2-3). As shown in figure 2-4, 19 % of all the reservoirs were found to be in good condition, 6% need minor improvements and/or maintenance, while 75% need major rehabilitation or reconstruction. As for the wells, they are divided in two categories, namely functional and non-functional. However, a functional well may need various types of improvements to become efficient as it could be providing water intermittently or insufficiently. Overall, 42 % of the Hermel wells are currently non-functional (figure. 2-5).

Table 2-2 lists the two springs identified to date in the caza of Hermel as being used as a water source. The minimum and maximum flows for one of these springs are listed. However no information is available regarding the number of years/recordings on which these figures are based. For the other spring, no information whatsoever is available to date.

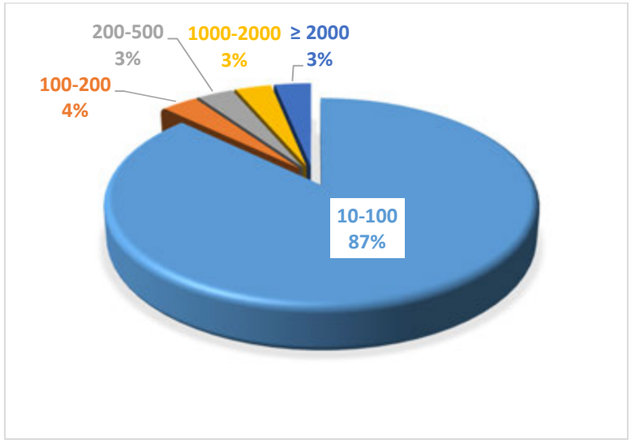


FIGURE 2-3: RESERVOIRS CAPACITY IN HERMEL CAZA (IN M^3)

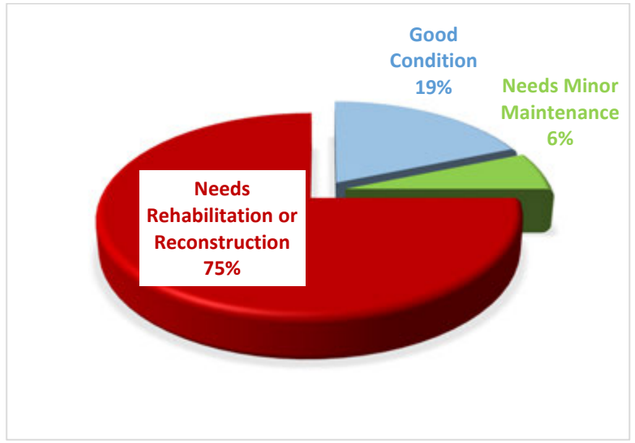


FIGURE 2-4: RESERVOIRS CONDITION IN HERMEL CAZA

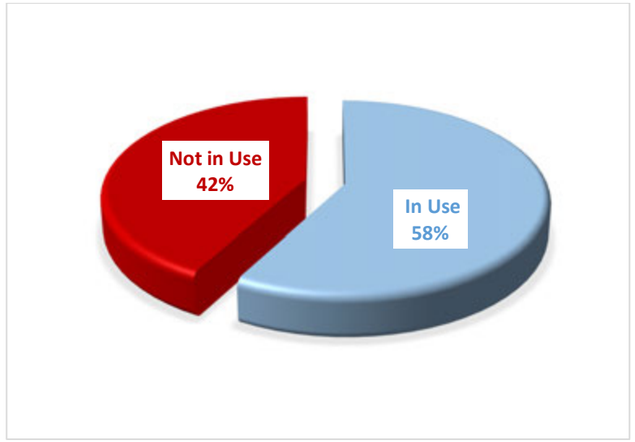


FIGURE 2-5: WELLS STATUS IN HERMEL CAZA

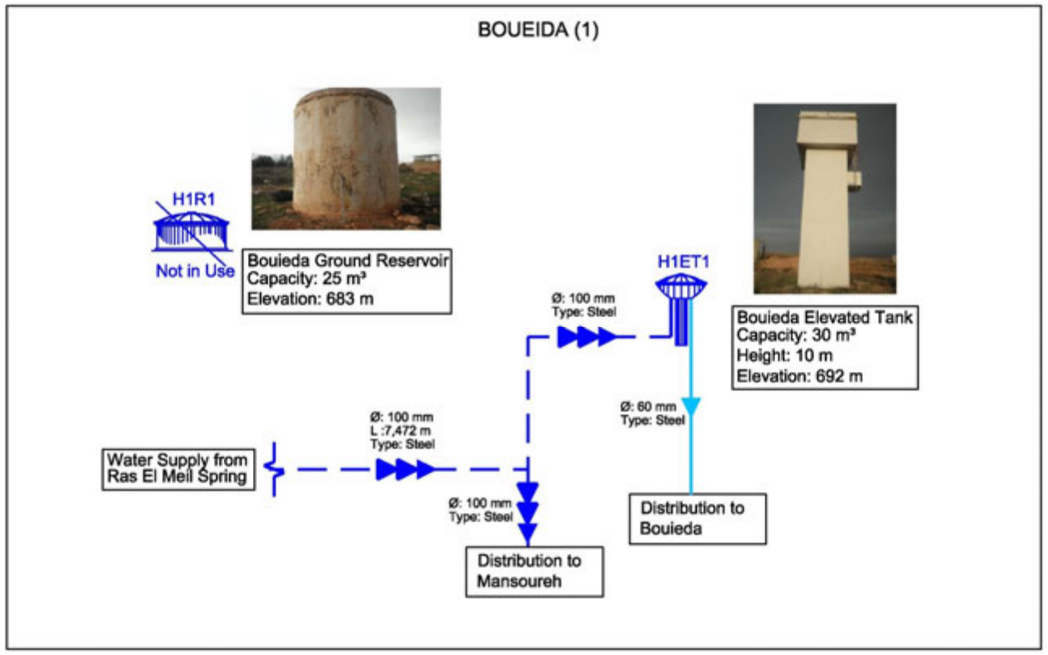
TABLE 2-2: SPRINGS IN HERMEL CAZA

Casa	Spring Name	Village	Code	Elevation	Min. Flow (L/S)	Max. Flow (L/S)	Avg. Flow (L/S)	Comments
Hermel	Aroubeh & maabour	Hermel	H10S1	1632m				
	Ras el meil	Boueida	H1S1	766m	10	100		BWE database

Legend:


LEGEND:
Gravity Pipe - Existing
Pressure Pipe - Existing
Pump Station - Existing
W.T.P
WTP
Well - Existing
Spring
Elevated Tank - Existing
Reservoir - Existing
CL
Chlorinator

Boueida (1)

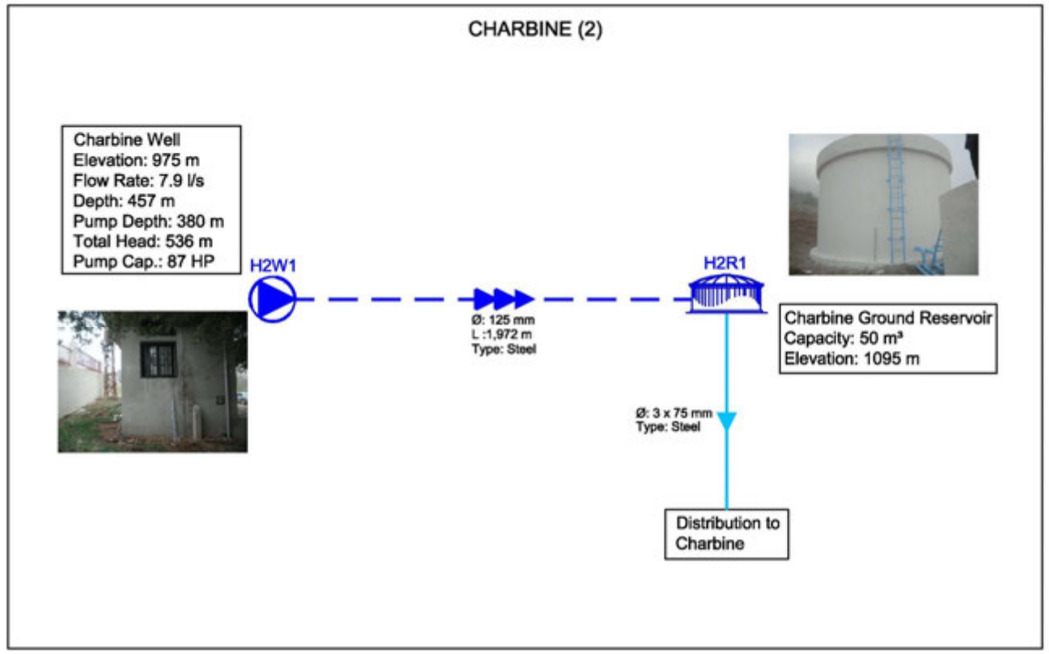


The existing water network is very old and it is in bad condition.

Reservoir H1R1 (25 m³): Reservoir is very old and it is in bad condition. It is not in use.

Elevated tank H1ET1 (30 m³): Elevated tank is very old and it is in bad condition. It needs rehabilitation.

Charbine (2)



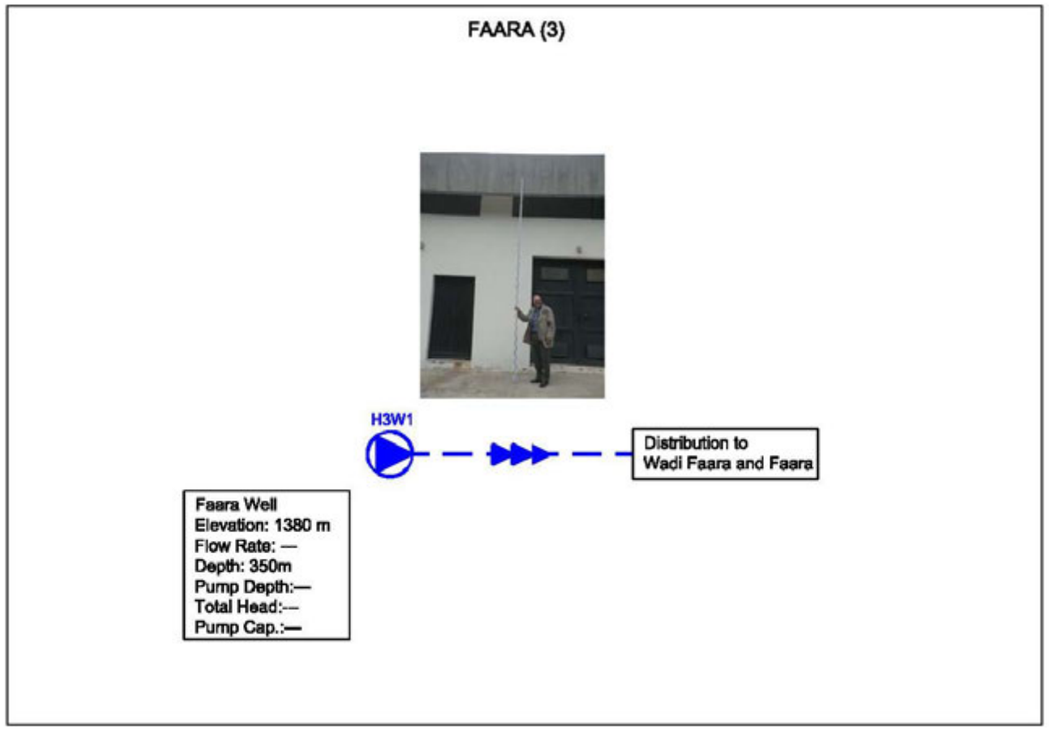
The existing water network is in bad condition and it has a length of around 2.3 km. It covers a part of the town.

There is some question mark about the reported well data as the listed head is not sufficient to supply the reservoir with water from the well.

Well H2W1 (15 years old): Well is in good condition. It includes power generator and small but non-functioning chlorination room. Generator is not always operating.

Reservoir H2R1 (50m³): Reservoir is in good condition.

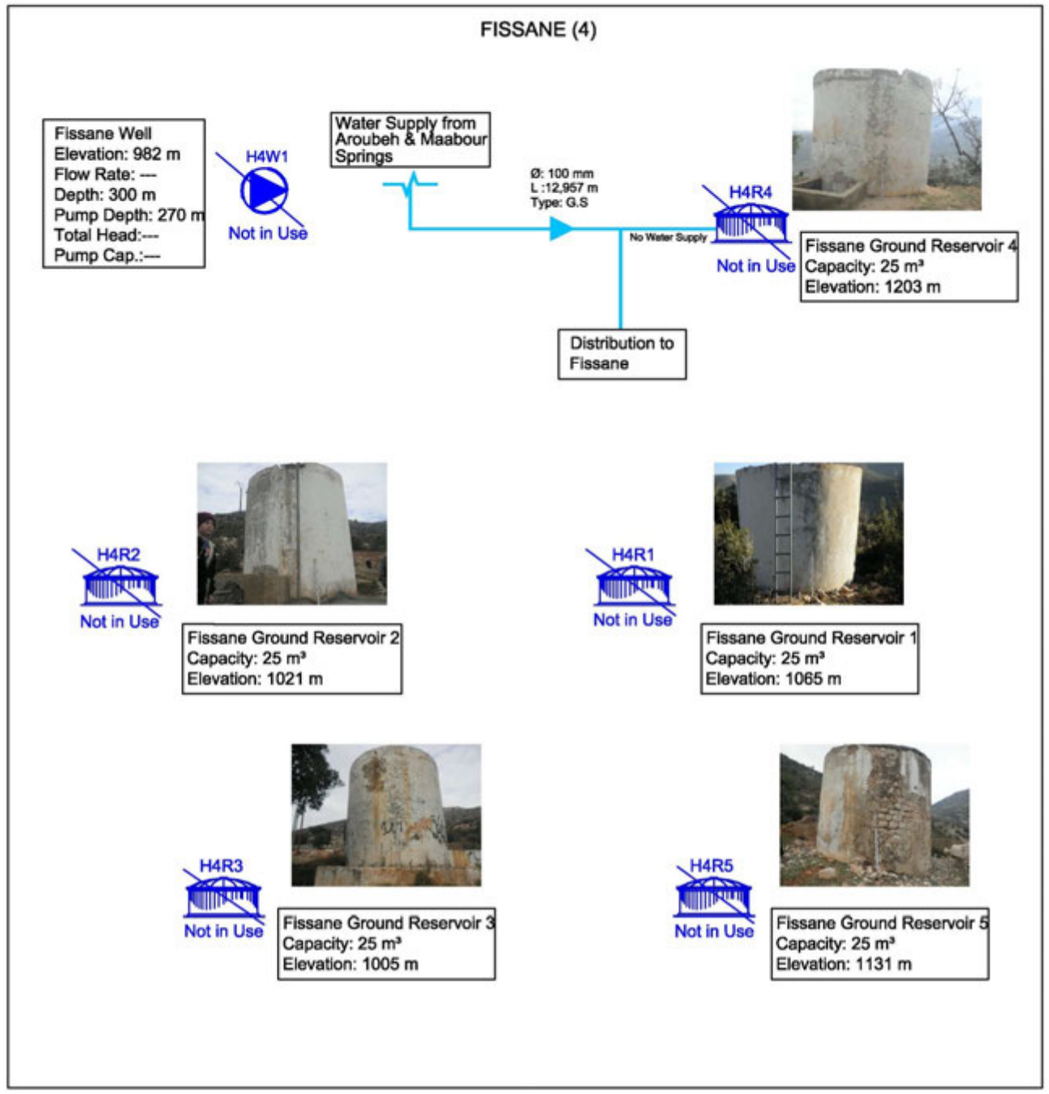
Faara (3)



There is no available information concerning the water network of the town.

Well H3W1: Well is inaccessible. No more available information.

Fissane (4)

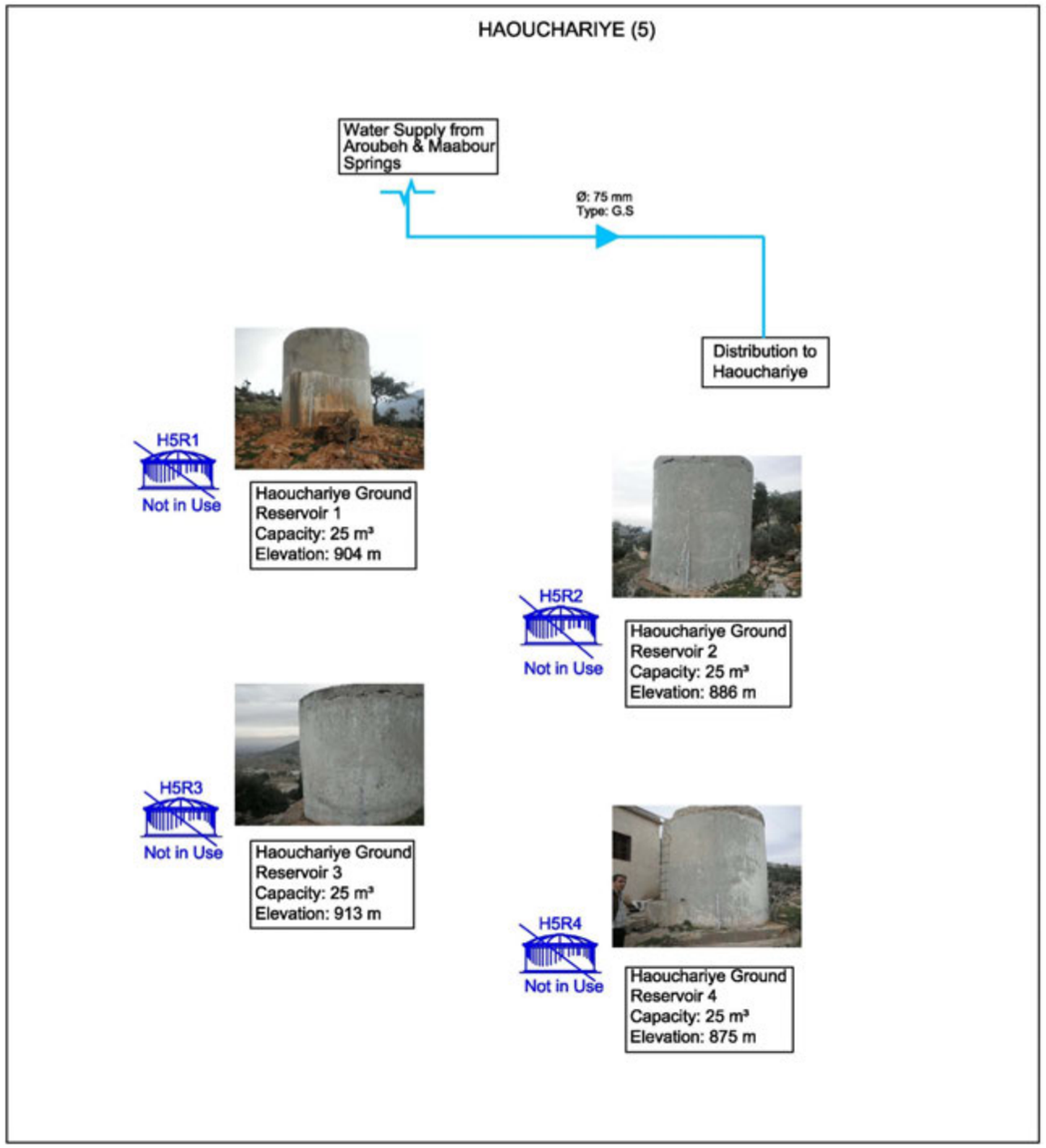


No available information concerning the existing water network.

Well H4W1 (20 years old): Well is not in use.

Reservoir H4R1, H4R2, H4R3, H4R4 & H4R5 (25m³): Reservoirs are not in use. They are broken or in very bad conditions. They need rehabilitation or reconstruction.

Haouchariye (5)



The existing network is unused (installed 50 years ago) and it is in a bad condition.

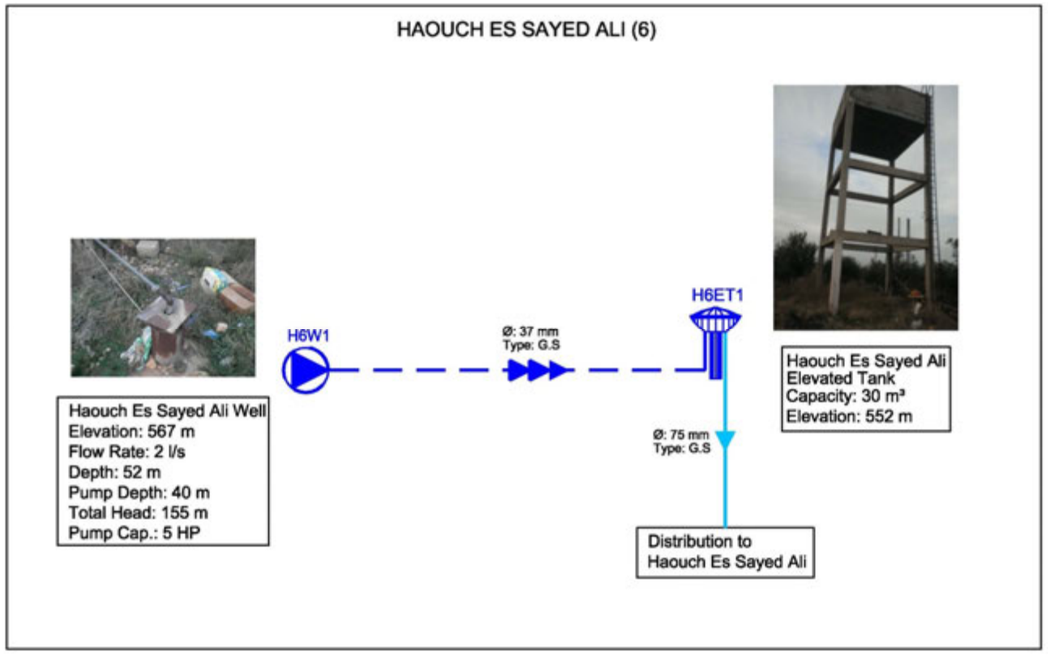
Reservoir H5R1 (25m³): Reservoir is very old and it is in bad condition. It needs rehabilitation or reconstruction. It is not in use.

Reservoir H5R2 (25m³): Reservoir is old but it is in acceptable condition. Its pipes are visible and valves are broken. This reservoir needs rehabilitation. It is not in use.

Reservoir H5R3 (25m³): Reservoir is in bad condition. It is subjected to heavy leakage. This reservoir is not connected to the main network. It needs rehabilitation or reconstruction. It is not in use.

Reservoir H5R4 (25m³): Reservoir is in acceptable condition. Its pipes are visible and valves are broken. This reservoir is not connected to the main network. It needs rehabilitation. It is not in use.

Haouch es Sayed Ali (6)

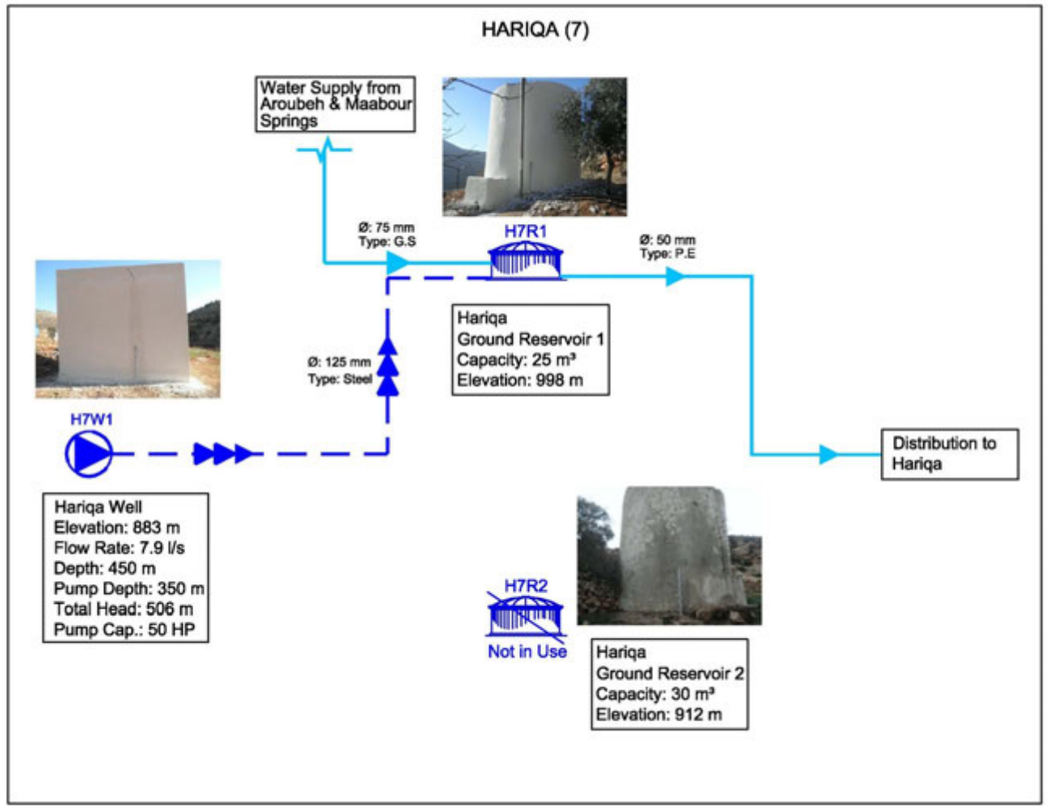


No available information concerning the existing water network.

Well H6W1 (15 years old): Well suffers from a shortage of electric power. This well is in bad condition and needs rehabilitation.

Elevated tank H6ET1 (30m³): Elevated tank is very old and it is in bad condition. It needs structural and esthetical rehabilitation.

Hariqa (7)



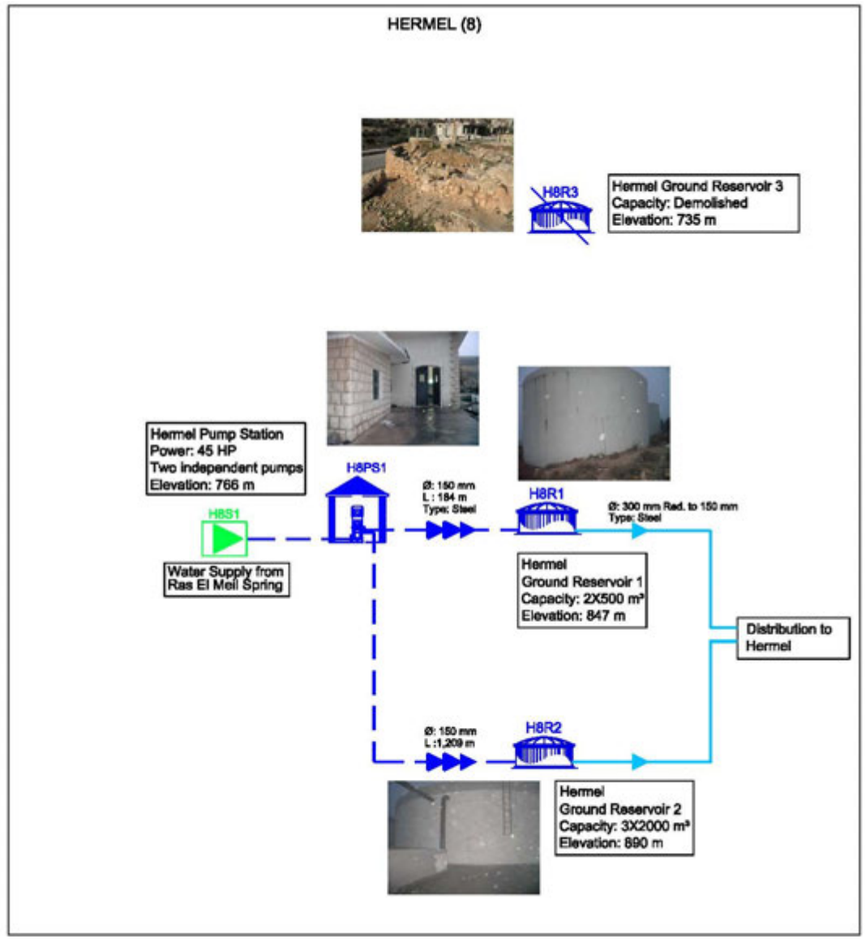
There is no available information concerning the water network of the town.

Well H7W1 (<15 years): Well is new and it is in good condition.

Reservoir H7R1 (25m³): Reservoir is old but it is rehabilitated lately. It is in good condition.

Reservoir H7R2 (30m³): Reservoir is very old and it is in bad condition. This reservoir is not in use and it needs reconstruction.

Hermel (8)



The existing water network is in bad condition and it has a length of around 61.6 km. It covers a part of the town.

Pump station H8PS1: Pump station is old and it needs rehabilitation. There is a chlorination unit but it is non-functional.

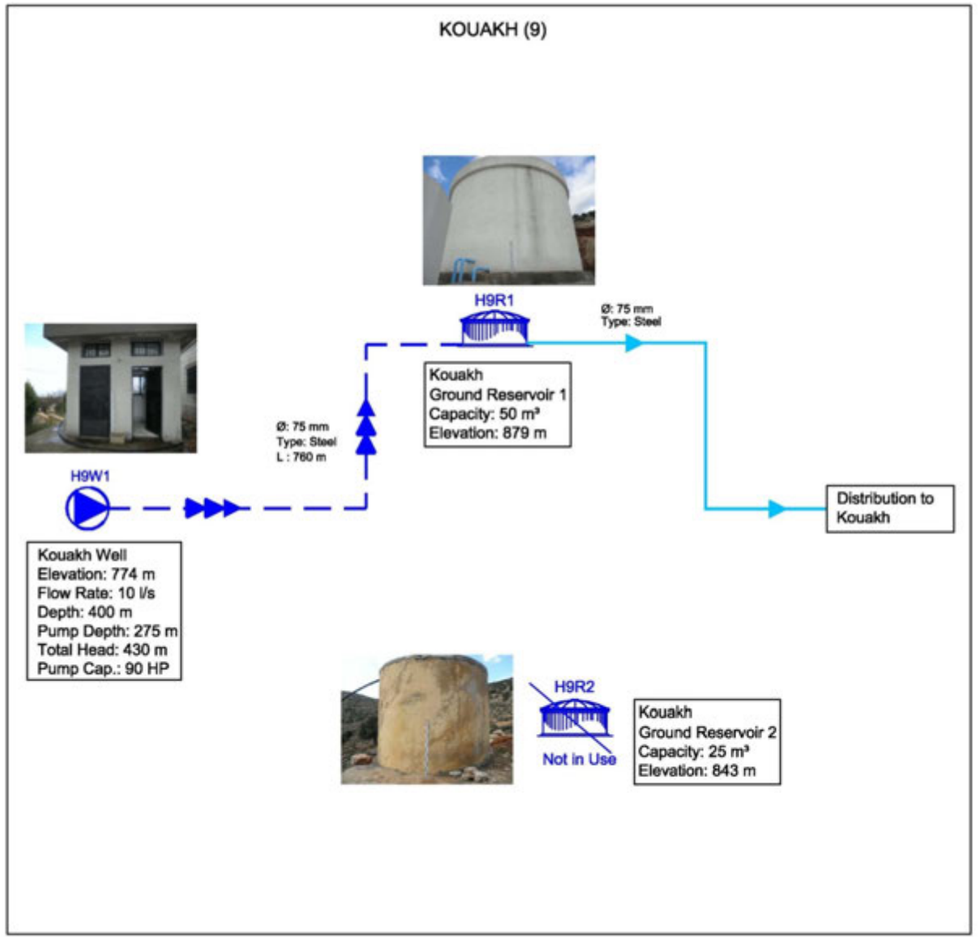
Reservoir H8R1 (2x500 m³): Reservoirs are old but they are in an acceptable condition. Their valves are rusted and they need to be replaced. These reservoirs need some minor maintenance.

Reservoir H8R2 (3x2000 m³): Reservoirs are new and they are in a very good condition.

Reservoir H8R3 (<5 years): Reservoir is demolished. It is not in use.

Spring H8S1: Spring runs into an open concrete channel until it reaches a 150mm pipe diameter which is linked to a pump station. No more available information.

Kouakh (9)



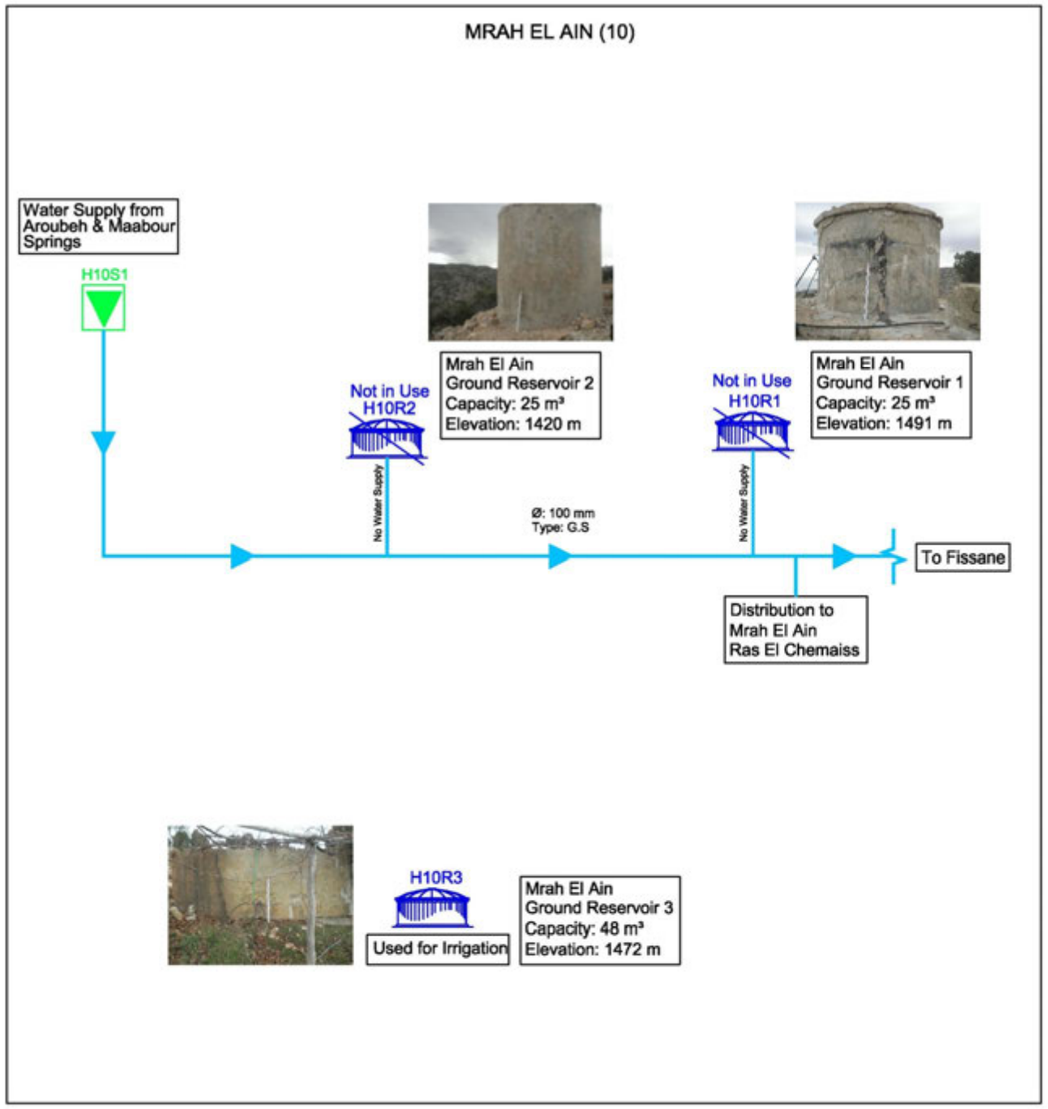
The existing water network is in bad condition and it has a length of around 3 km. It covers a part of the town.

Well H9W1 (20 years old): Well is in good condition. A small chlorination unit exists but is not functioning. Generator is in good condition.

Reservoir H9R1 (50m³): Reservoir is in good condition.

Reservoir H9R2 (25m³): This reservoir is not in use and its structure is in very poor condition with large cracks and bullet marks appearing along its length. Rehabilitation is needed.

Mrah el Ain (10)

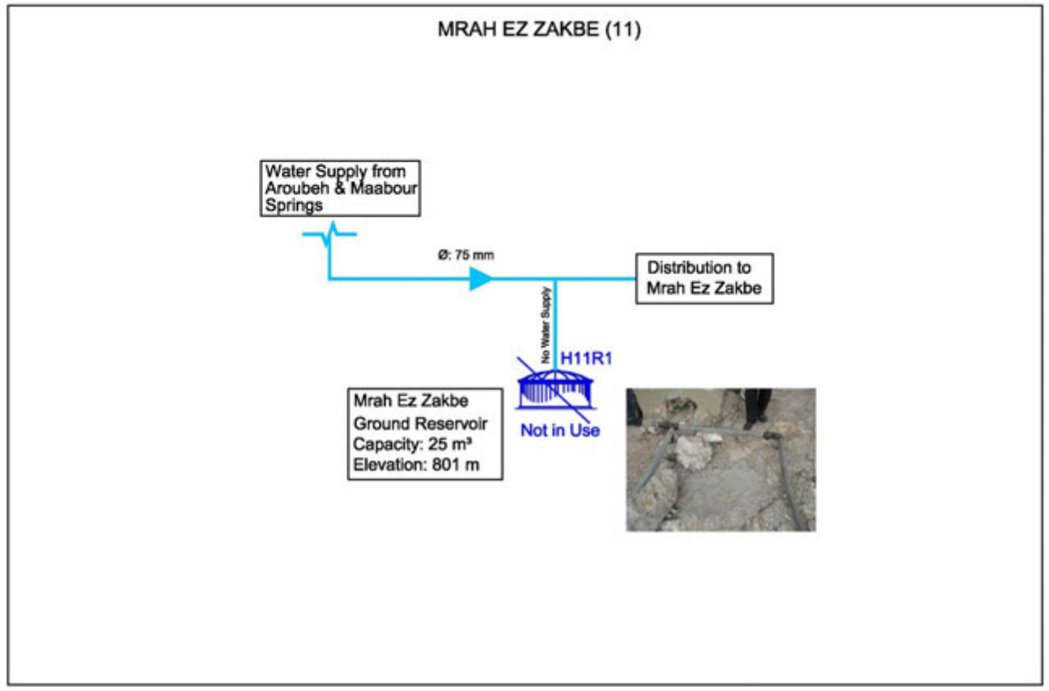


There is no available information concerning the water network of the town.

Spring H10S1: no available information.

Reservoir H10R1 (25M³), H10R2 (25M³), AND H10R3 (48M³): Reservoirs are not in use and they are in bad condition. They are subjected to leakage. They need rehabilitation or reconstruction.

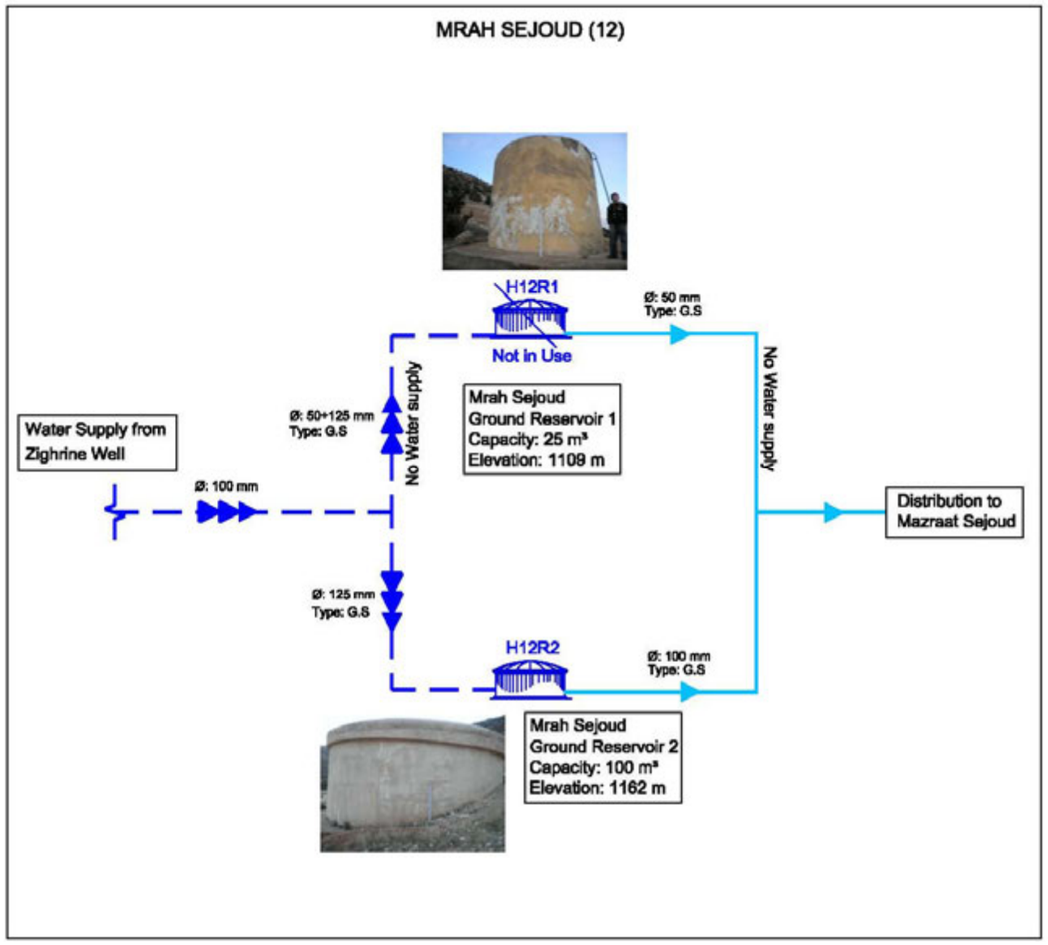
Mrah ez Zakbe (11)



There is no available information concerning the water network of the town.

Reservoir H11R1 (25 m³): Reservoir is very old and it is not in use. There is a diversion next to it. No more available information.

Mrah Sejoud (12)

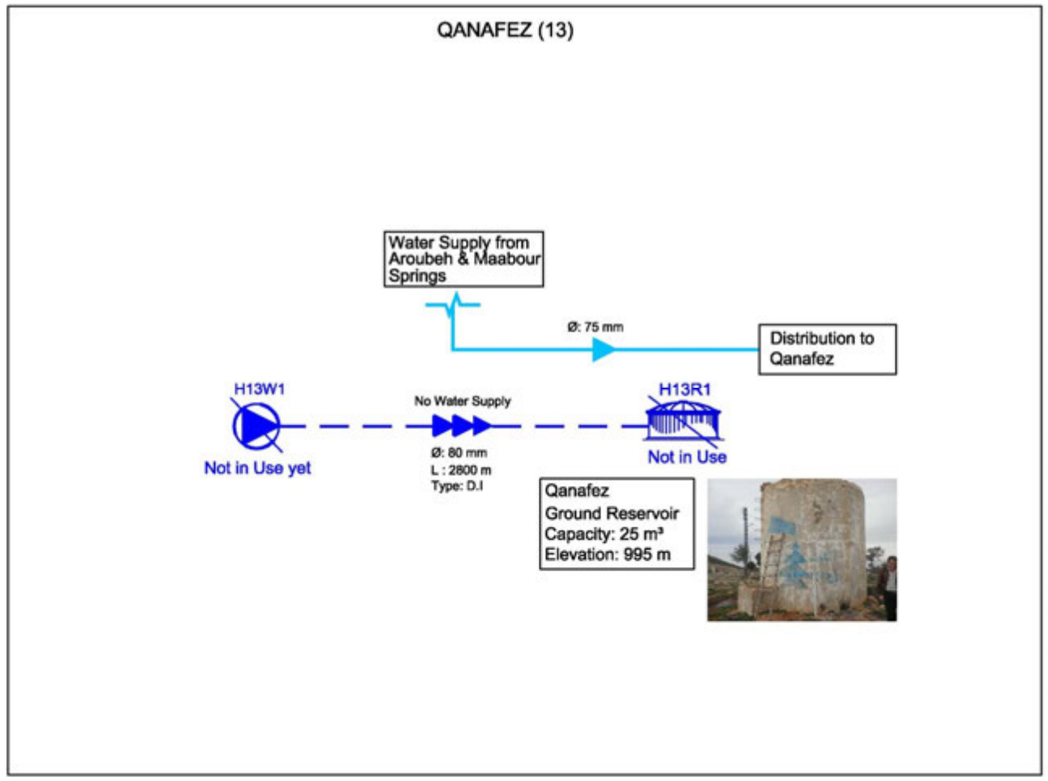


There is no available information concerning the water network of the town.

Reservoir H12R1 (25m³): Reservoir is in bad condition and it is not in use. The inlet and outlet pipes are unfilled with water but there is no available information regarding their conditions. This reservoir needs rehabilitation or reconstruction.

Reservoir H12R2 (100m³): Reservoir is in good condition but valves are rusted. It needs minor maintenance.

Qanafez (13)

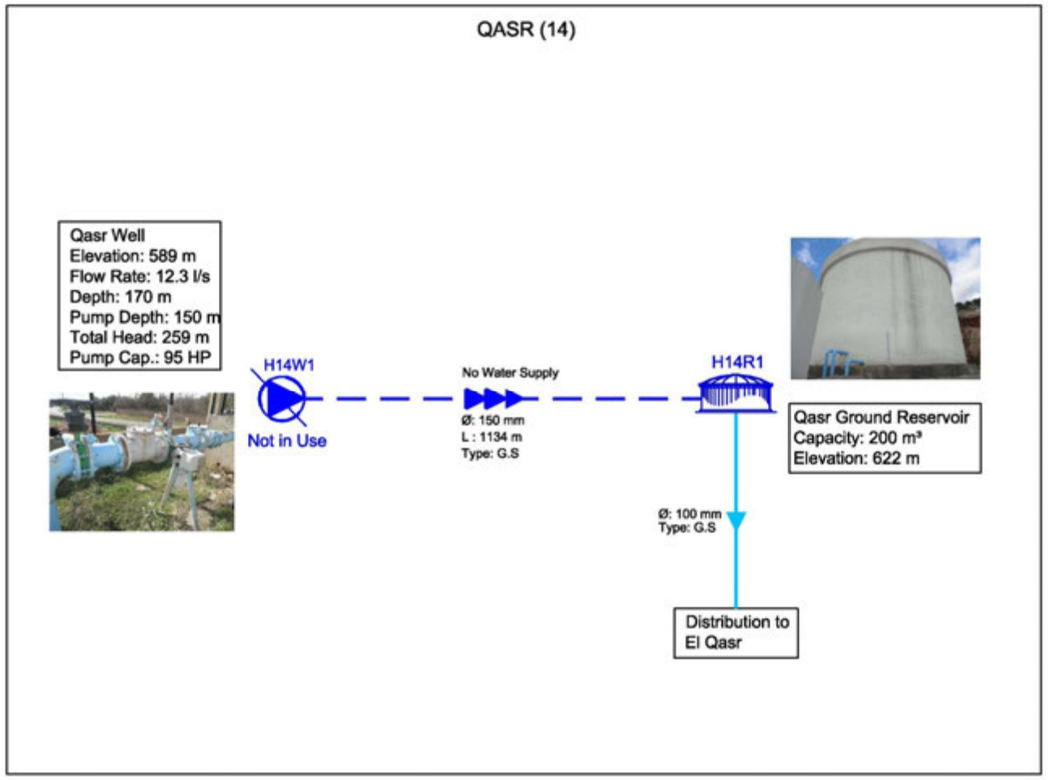


The existing network is not in use (installed 50 years ago) and it is in very bad condition. Actually, people are supplied with water from a private small reservoir located in a school inside the town

Well H13W1: A new well is under construction. It is not in use yet.

Reservoir H13R1 (25m³): Reservoir is not in use. It is in bad condition but it will be rehabilitated soon.

Qasr (14)

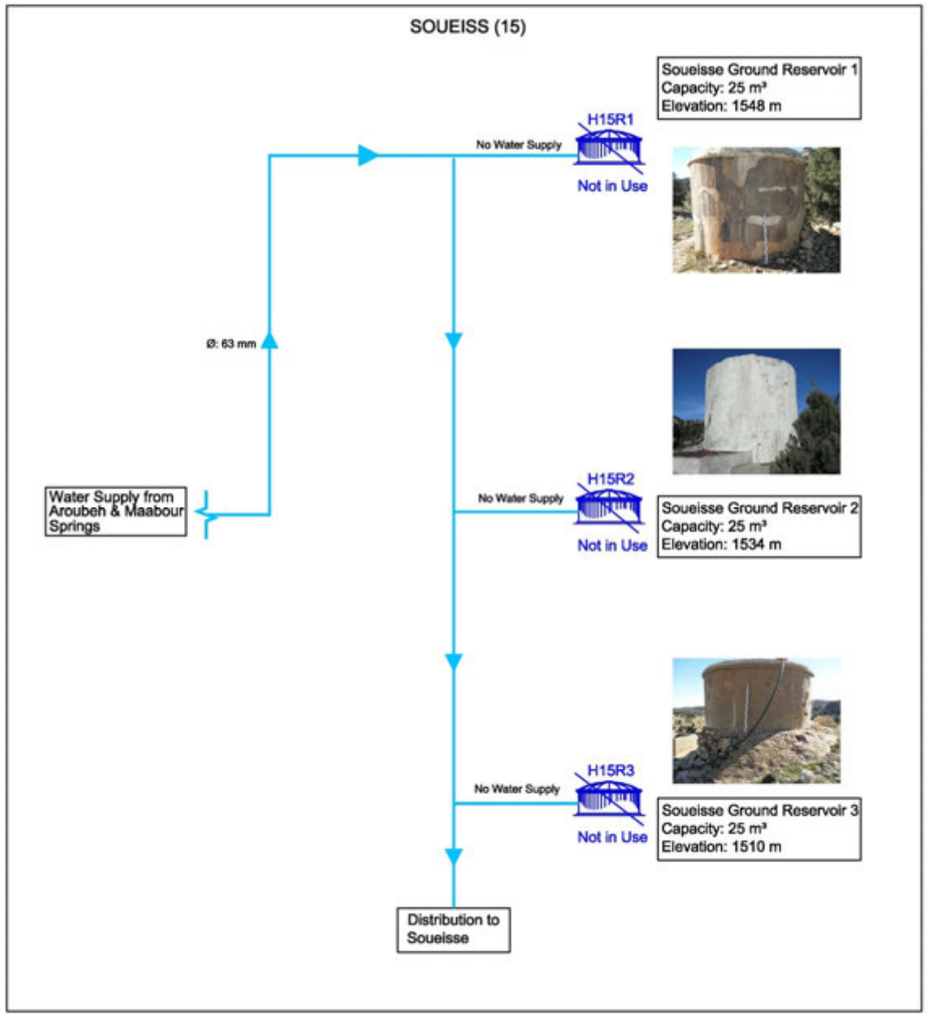


The existing water network is in bad condition and it has a length of around 38 km. It covers a large area of the town. This town has around 1200 private wells.

Well H14W1 (15 years old): This well is not in use during visit time because its electrical components are stolen. Well suffers from a shortage of electric power. There are two generators, one new and the other one is old. Also there is a chlorination unit but it is non-functional. This well needs rehabilitation.

Reservoir H14R1 (200 m³): Reservoir is in good condition but it is not equipped for use and not connected to any network.

Soueiss (15)



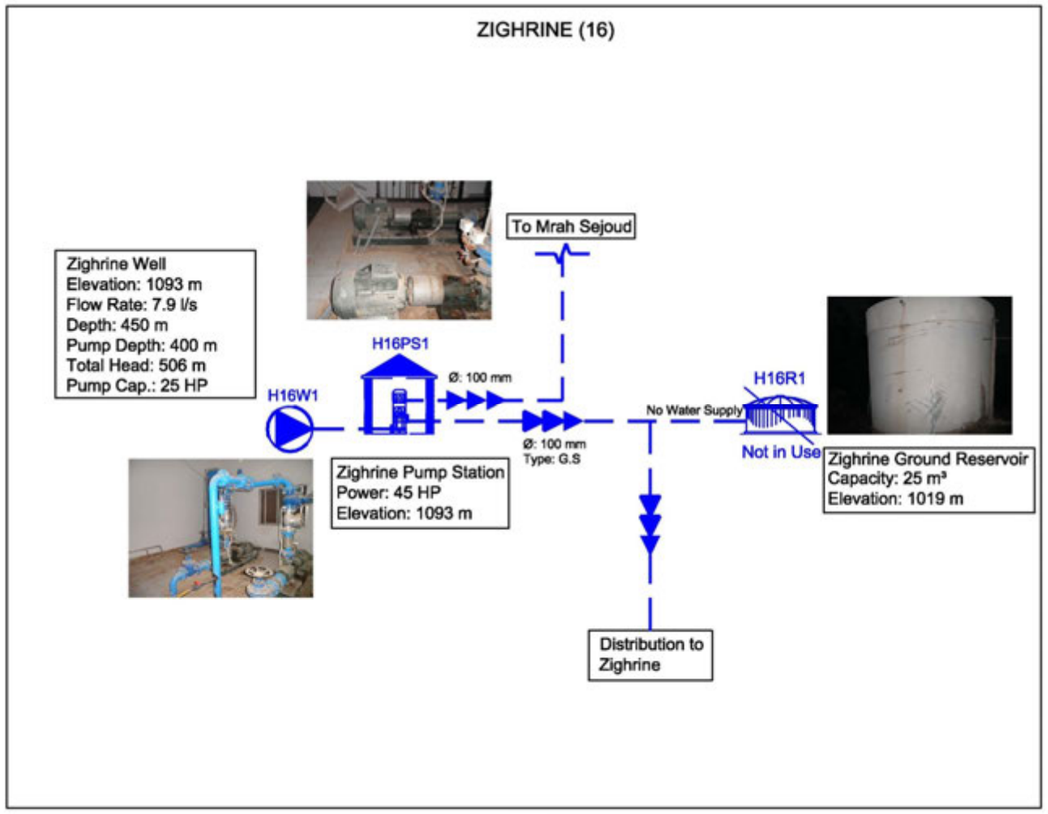
There is no available information concerning the water network of the town.

Reservoir H15R1 (25 m³): Reservoir is not in use. It is in very bad condition. The inside cannot be accessed as the steps are missing. This reservoir needs reconstruction.

Reservoir H15R2 (25 m³): Reservoir is not in use. It is in very bad condition. The structure is damaged and the pipe intakes openings are destroyed. It needs reconstruction.

Reservoir H15R3 (25 m³): Reservoir is not in use. It is in very bad condition. The inside cannot be accessed as the steps are missing. This reservoir needs reconstruction.

Zighrine (16)



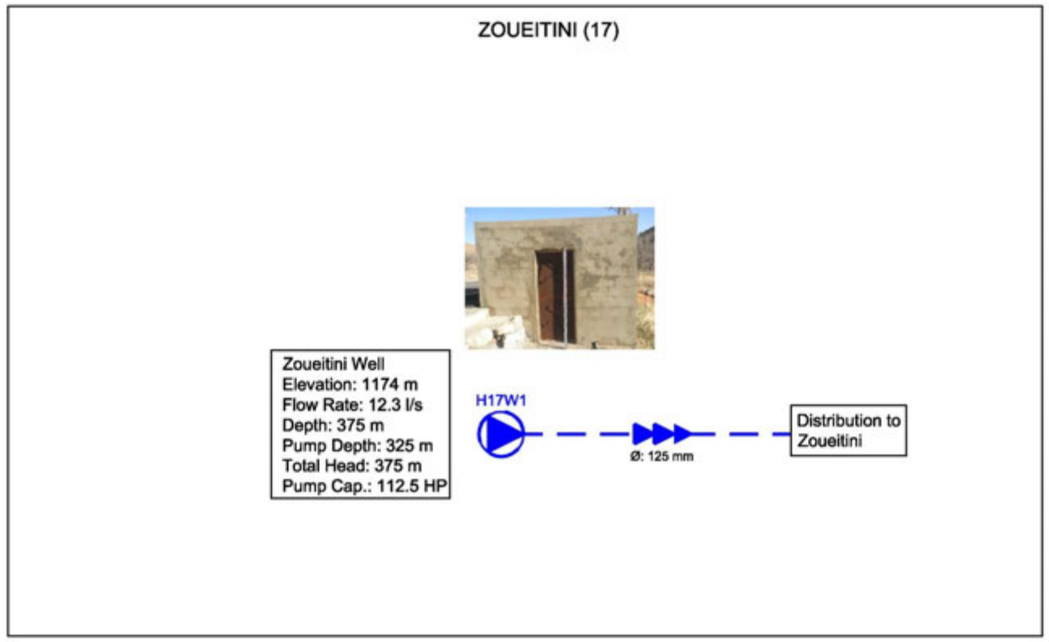
There is no available information concerning the water network of the town.

Well H16W1 (>15 years): Well is in good condition but it suffers from a shortage of electric power. Also there is a small chlorination unit but it is non-functional.

Pump station H16PS1: Pump station is in good condition. No more available information.

Reservoir H16R1 (25 m³): Reservoir is in good condition but it is not in use. No more available information.

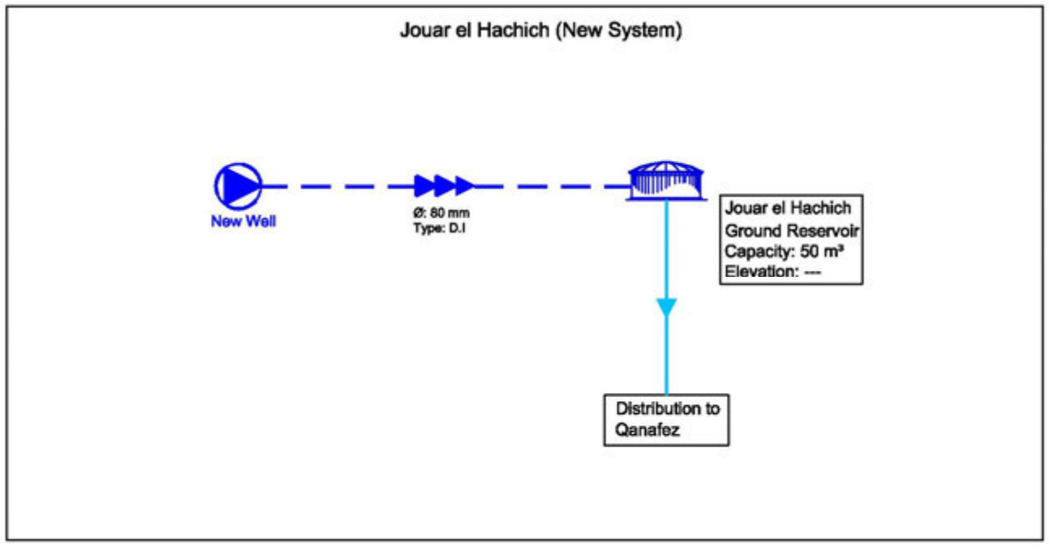
Zoueitini (17)



There is no available information concerning the water network of the town.

Well H17W1 (15 years old): Well is in acceptable condition but it is not in use.

Jouar el Hachich

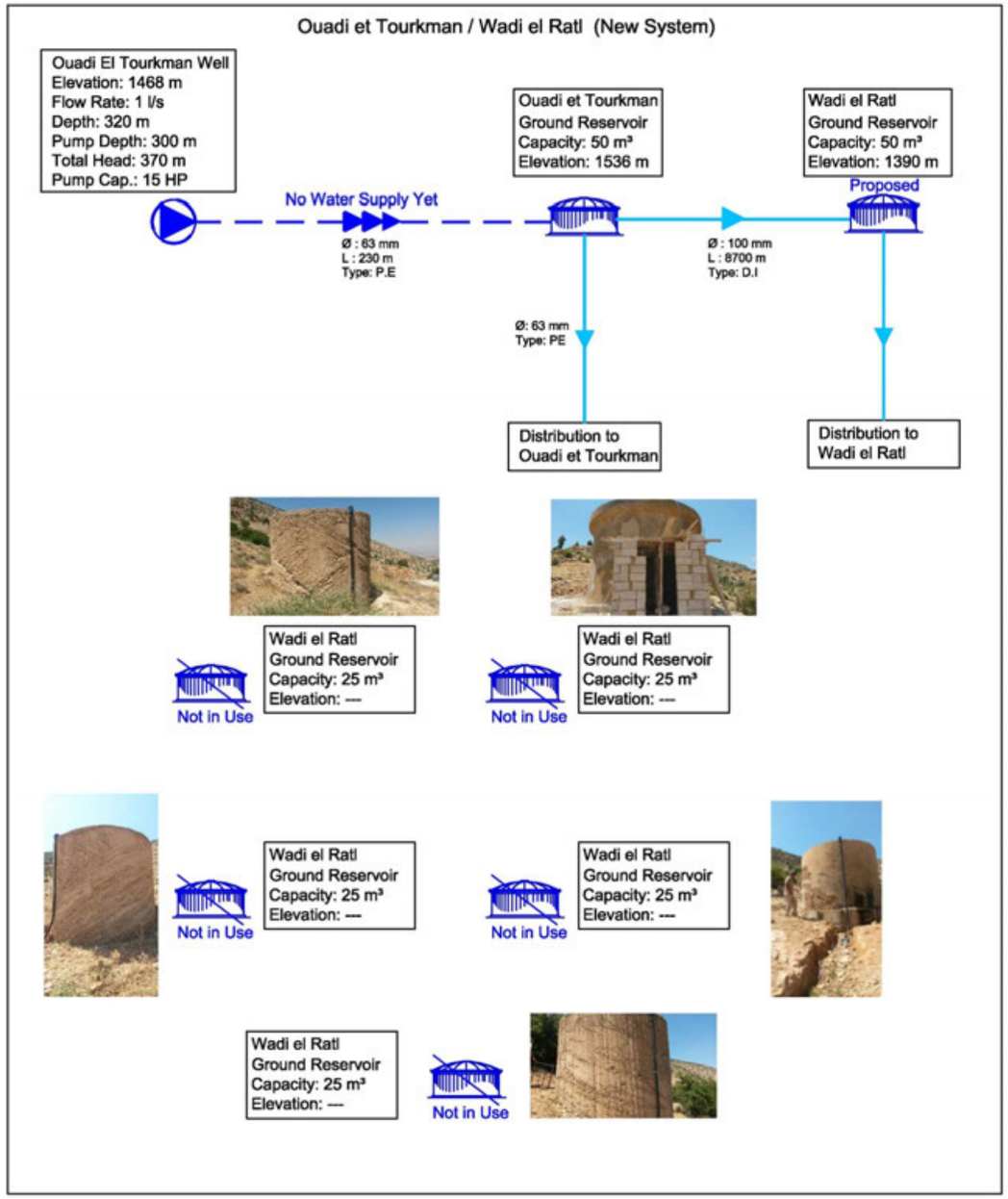


There is no available information concerning the water network of the town.

Well (<2 years old): Well is in good condition.

Reservoir (50 m³): Reservoir is new and it is in good condition.

Ouadi el Tourkman / Wadi el Ratl



There is no available information concerning the water network of the town. The system is recently constructed. There are 5 very old reservoirs and they are not in use.

3 BAALBECK CAZA

3.1 Water networks

As mentioned earlier, the data collection campaign carried over the course of several months included various undertakings, among which the survey conducted with the municipalities through the questionnaires and the phone interview. Table 3-1 summarizes the results of this survey. As can be seen, most municipalities answered, either in the questionnaire or over the phone, that they do have a water network. The age and status of the existing networks varied from very old to newly constructed.

Of the 44 municipalities that answered affirmatively regarding the existence of a water network, the layout could be obtained for all but two, namely Jenta and Maqné. However, the network in Jenta is very old and hence considered non-existent. Network layout maps were even obtained for two municipalities that declared not having a network (Haouch Tell Safiyé and Nabha).

Figures 3-1 and 3-2 show that only 2% of the Baalbeck population, representing 23% of the caza villages, is not served by any water network (existing or planned). These villages are generally very small (less than 500 people).

Plans 3-1, 3-2, 3-3 and 3-4 show the layout of the existing and planned water networks for the caza of Baalbeck as a whole, the city of Baalbeck and the areas of north and south Baalbeck respectively.

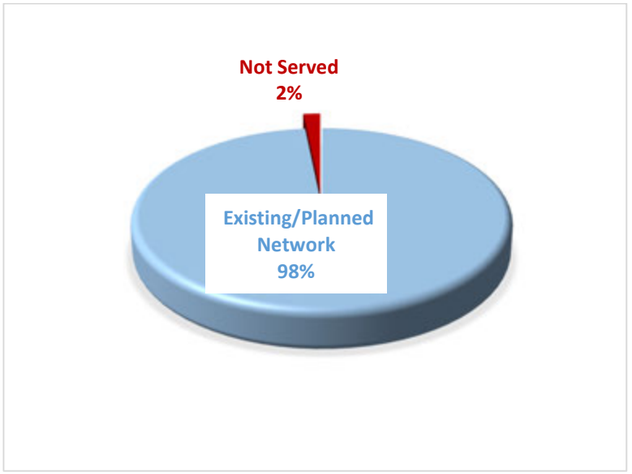


FIGURE 3-1: PERCENTAGE OF POPULATION SERVED BY WATER NETWORKS IN BAALBECK CAZA

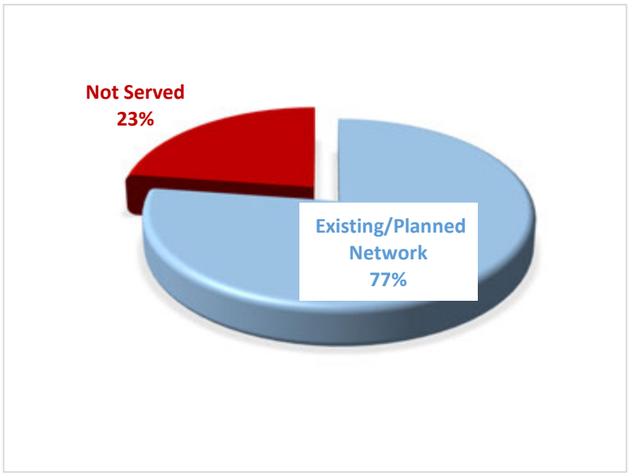


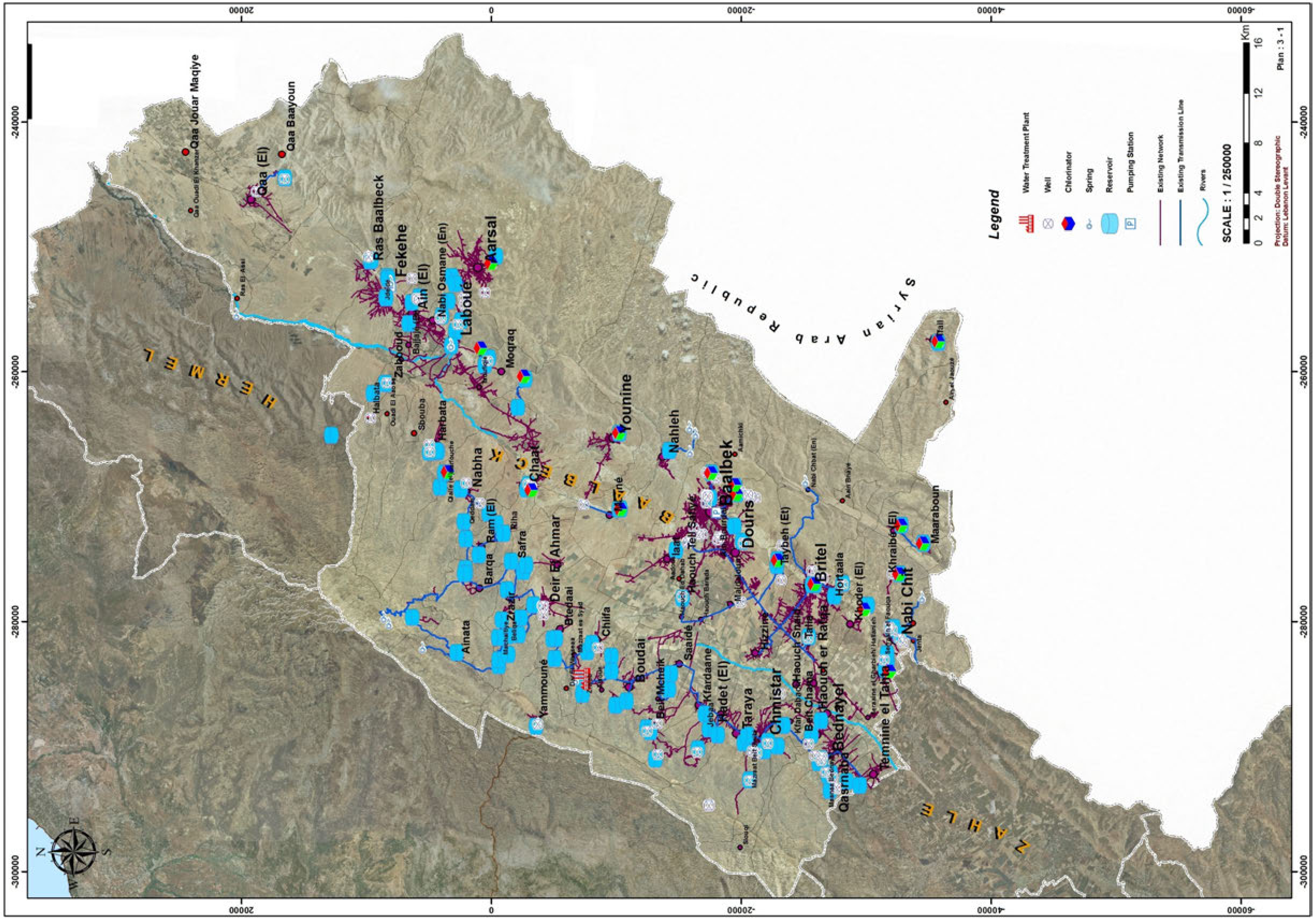
FIGURE 3-2: PERCENTAGE OF VILLAGES SERVED BY WATER NETWORKS IN BAALBECK CAZA

TABLE 3-1: WATER NETWORK STATUS IN CAZA OF BAALBECK

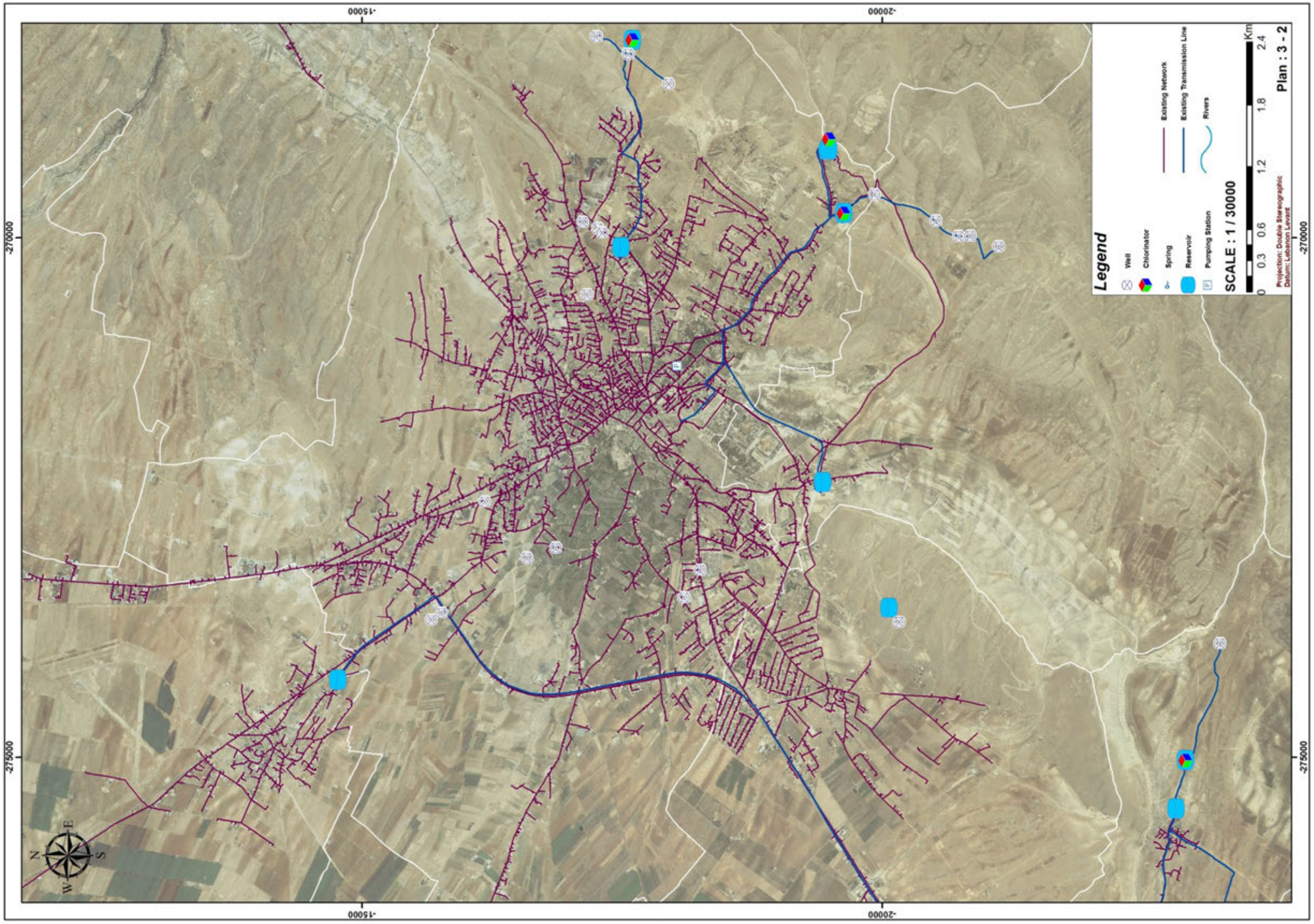
Caza		Village Name	Information From Questionnaire/Phone Interview						Response Of Municipality To Phone Request For Water Maps	Network Maps Availability Status
			Wells	Spring	Water Network	Water Source	Network Construction Date (Year)	Status Of Water Network According To Municipality		
Baalbeck	1	**Aarsal**	Yes	No	Yes	No Answer	No answer	* New network is in good condition * This network is not covering all town	Did not call - data available already	Obtained - existing network
	2	**Ain (el)**	No answer	No answer	Yes	Springs	2 years old	* Network is in good condition	Told us to go to BWE	Obtained - existing network
	3	**Ainata**	No	Yes	Yes	No Answer	No answer	* Network is very old (bad condition) *Diameter ranges between 1" and 4"	Did not call - data available already	Obtained - existing network
	4	**Baalbeck**	No answer	No answer	Yes	No Answer	No answer	No answer	Did not call - data available already	Obtained - existing network
	5	**Barqa**	No answer	No answer	Yes	Ouyoun Orghoch Spring	13 years old	* Network is in use (bad condition)	Told us to go to BWE	Obtained - existing network
	6	**Bechouat**	No	No	Yes	No Answer	No answer	* Network is in use (medium condition)	Did not call - data available already	Obtained - existing network
	7	**Britel**	No answer	No answer	Yes	Spring & Well	2012 - 2013	* Network is in good condition	Told us to go to the municipality	Obtained - existing network
	8	**Btedaai**	No answer	No answer	Yes	Yammouneh & Dar El Wasiaa Springs	5 years old	* Network is in bad condition	Promised to help but did not follow through	Obtained - existing network
	9	**Chaat**	No answer	No answer	Yes	Well	40 years old	* Network is in bad condition * It is repaired by the municipality	Did not call - data available already	Obtained - existing network
	10	**Chlifa**	No answer	No answer	Yes	Yammouneh Spring	50 years old & new	* Old network is in use (bad condition) * New network is not in use	Told us to go to tajj company	Obtained - existing new network
	11	**Chmistar**	No answer	No answer	Yes	Yammouneh Spring	45 years old	* Network is in use (bad condition)	Told us to go to BWE	Obtained - existing network
	12	**Deir el ahmar**	No	No	Yes	Ouyoun Orghoch & Yammouneh Spring	10 years old	* Network is in use (medium condition) * Pipe diameters range between 1" and 3"	Promised to help but did not follow through	Obtained - existing new network
	13	**Douris**	Yes	No	Yes	No Answer	No answer	* New water network installed but needs rehabilitation and expansion	Did not call - data available already	Obtained - existing network
	14	**Fekehe**	No answer	No answer	Yes	Fekhe Well	2004 - 2011	* Network is in use but is polluted	Not available at municipality	Obtained - existing network
	15	**Hadet (el)**	No answer	No answer	Yes	Yammouneh Spring	2002	* Network is in use	Told us to go to BWE	Obtained - existing network
	16	**Haouch barada**	Yes	No	Yes	No Answer	No answer	* New network was installed (not covering all town) * Some pipes of this network were stolen	Did not call - data already available	Obtained - existing network
	17	**Haouch er rafqa**	No answer	No answer	Yes	Well	13 years old	* Network is in use	Told us to go to CDR	Obtained - existing network

Caza		Village Name	Information From Questionnaire/Phone Interview						Response Of Municipality To Phone Request For Water Maps	Network Maps Availability Status
			Wells	Spring	Water Network	Water Source	Network Construction Date (Year)	Status Of Water Network According To Municipality		
	18	**Haouch snaid**	No answer	No answer	Yes	No Water Source	2007	* Network not in use because no water source	Told us they don't know where maps can be obtained from	Obtained - part of the existing network
	19	**Haouch tell safiyé aaddous**	Yes	No	No	No Answer	No answer	No answer	No answer	Obtained - existing network
	20	**Harbata**	No answer	No answer	Yes	Well	1 year old	* Network is in use and in good condition	Told us to go to Mussawi company	Obtained - existing network
	21	**Hizzine**	No answer	No answer	Yes	No Water Source	3 years old	* Network is in good condition but not in use	Told us they don't know where maps can be obtained from	Obtained - existing network
	22	**Iaat**	No answer	No answer	Yes	Wells	4 years old	* Network is in use	Told us to go to CDR	Obtained - existing network
	23	**Jabboulé**	No answer	No answer	Yes	No Source	3 years old	* Network not in use because no water source	Not available at municipality	Obtained - existing network
	24	**Jebaa**	No answer	No answer	Yes	Yammouneh Well	2004	* Old network is in bad condition * new network is in good condition	Not available at municipality	Obtained - existing network
	25	**Jenta**	No answer	No answer	Yes	Spring	50 years old	* Network is in use and very old (bad condition)	Not available at municipality	Not obtained
	26	**Khoder (el)**	No answer	No answer	Yes	Well	5 years old	* Network is in use	Told us to go to al Mussawi company	Obtained - existing network
	27	**Khraibé (el)**	No answer	No answer	Yes	Well	10 years old	* Network is in use but in bad condition	Told us to go to BWE	Obtained - existing network
	28	**Maaraboun**	No answer	No answer	Yes	Ham Well	More than 10 years	* Network is in use (bad condition)	Told us to go to Zakhem contractor	Obtained - existing network
	29	**Majdaloun**	Yes	No	Yes	Two Wells In The Town	Very old & new	* Old network is in bad condition * New network is still non operational	Told us to go to Zakhem contractor	Obtained - existing new network
	30	**Maqné**	No answer	No answer	Yes	Younine Spring	1997 - 2000	* Network is in use (good condition)	Municipality refused to give us the maps	Not obtained
	31	**Nabha**	No answer	No answer	No	Ouyoun Orghoch Well	2000 - 2010	* Network is in use (bad execution)	Promised to help but did not follow through	Obtained - existing network
	32	**Nabi chit (en)**	No answer	No answer	Yes	Well	2002	* Network is in use	Told us to call al danach company	Obtained - existing network
	33	**Nabi osmane (en)**	No answer	No answer	Yes	Well In Nabi Osmane Mountain	Lately	* Network is still not operational	Told us to call nazih braydi company	Obtained - existing network

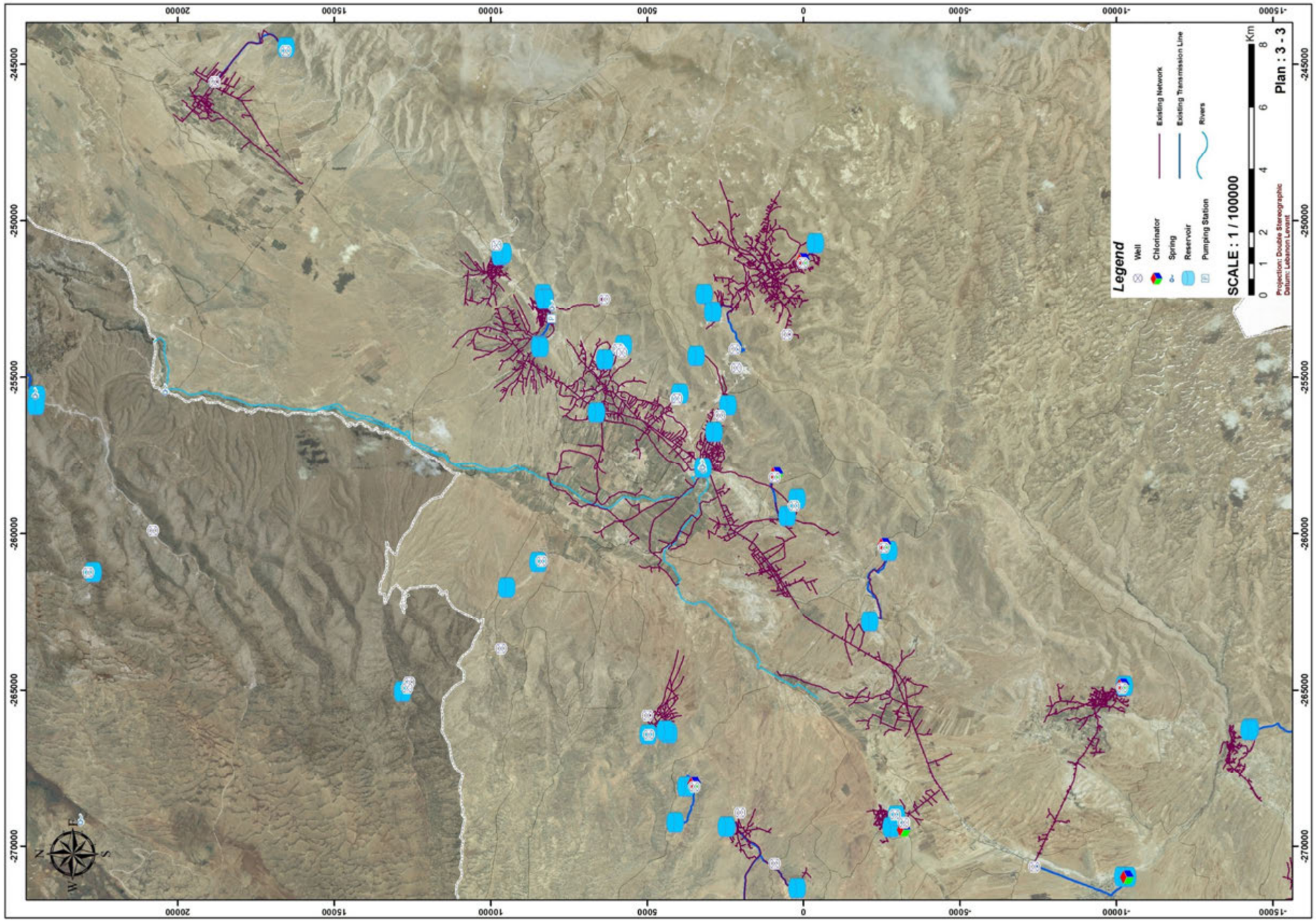
Caza		Village Name	Information From Questionnaire/Phone Interview						Response Of Municipality To Phone Request For Water Maps	Network Maps Availability Status
			Wells	Spring	Water Network	Water Source	Network Construction Date (Year)	Status Of Water Network According To Municipality		
	34	**Nahlé**	No	Yes	Yes	No Answer	No answer	* Old network is in bad condition * New network is still non operational	Did not call - data available already	Obtained - existing new network
	35	**Qarha**	No	No	Yes	No Answer	No answer	* Network is in good condition and needs some rehabilitations.	Did not call - data available already	Obtained - existing network
	36	**Qasrnaba**	No answer	No answer	Yes	Spring	1985	* Network is in good condition	Told us to contact BWE	Obtained - existing network
	37	**Ram (el)**	No	No	Yes	Ouyoun Orghoch Spring	No answer	* Network is in good condition * Pipe diameters range between 1" and 3"	Did not call - data already available	Obtained - existing network
	38	**Ras Baalbeck**	Yes	Yes	Yes	No Answer	No answer	* Network is in bad condition * Pipe diameters range between 0.5"&10"	Did not call - data already available	Obtained - existing network
	39	**Saaidé**	No answer	No answer	Yes	Yammouneh Spring	2005	* Network is in use	Told us to connect danach company	Obtained - existing network
	40	**Seraain el tahta & el faouka**	Yes	No	Yes	Spring & Well	10 years old	* Network is in use * Pipe diameter range between 0.5" and 5"	Promised to help but did not follow through	Obtained - existing network
	41	**Talia**	No answer	No answer	Yes	Well	2009	* Network is in use	Told us to go to ridwan el moussawi company	Obtained - existing network
	42	**Taraya**	No answer	No answer	Yes	Yammouneh Spring	12 years old	* Network is in use (good condition)	Told us to go to tajj company	Obtained - existing network
	43	**Temnine el faouqa**	No answer	No answer	Yes	Well	10 years old	* Network is in use	Told us to contact BWE	Obtained - existing network
	44	**Temnine el tahta**	No answer	No answer	Yes	Well	10 years old	* Network is in use	Told us to contact BWE	Obtained - existing network
	45	**Zabboud**	No answer	No answer	Yes	Well	40 years old	* Network is in use (bad condition)	Told us to go to mussawi company	Obtained - existing network
	46	**Zrazir**	No	No	Yes	No Answer	No answer	No answer	Did not call - data already available	Obtained - existing network



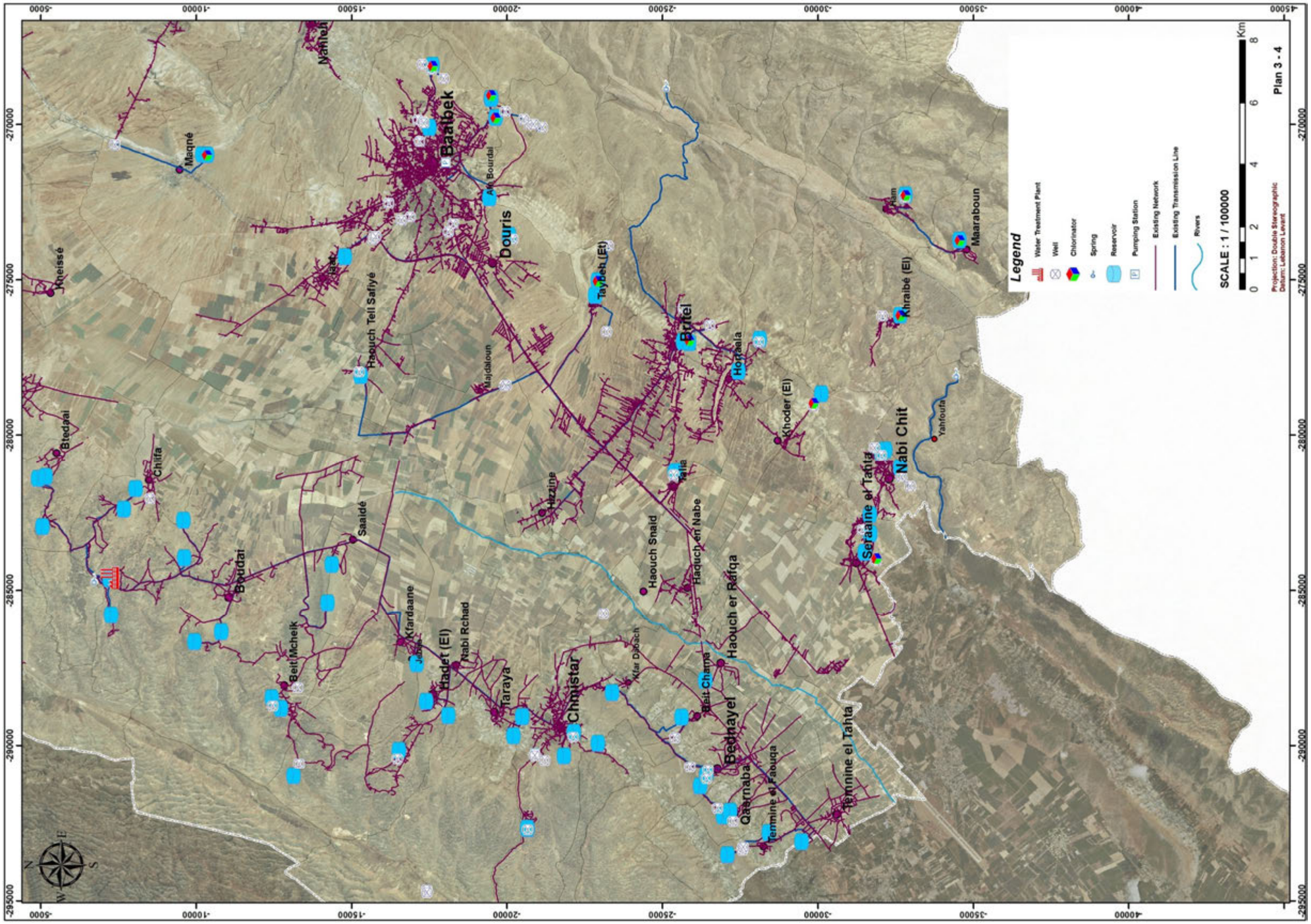
PLAN 3-1: WATER SYSTEMS FOR CAZA OF BAALBECK



PLAN 3-2: WATER SYSTEMS FOR CAZA OF BAALBECK - BAALBECK CITY



PLAN 3-3: WATER SYSTEMS FOR CAZA OF BAALBECK - NORTH



PLAN 3-4: WATER SYSTEMS FOR CAZA OF BAALBECK - SOUTH

3.2 Flaoui water distribution plant

The Flaoui water distribution plant (FWDP) is located on top of the hills in Flaoui (caza of Baalbeck). Although labeled as a treatment plant by BWE, it is actually just a distribution plant which receives water from the Yammoune spring and collects it before distributing it to customers. The maximum storage capacity of the reservoirs in this plant is 400 m³ filled continuously to serve ultimately 40,000 persons at a rate of 200 liters/person/day in year 2015. This plant serves the villages of: Flaoui, Temnine, Beit Chama, Kfardaane, Taraya, Saaidé, Chmistar. Beit Mcheik and Boudai and was constructed in 2010. A 5 km long network of cast iron steel, 20 inches in diameter, connects it to the Yammoune spring and an old distribution network, 45 km long, conveys the water to the various villages. The BWE is in charge of operating and maintaining this plant.

3.2.1 Plant process

The inflowing water is collected in a 200 m³ ground circular concrete tank. A manhole located 2 m below the reservoir receives the water and discharges it into 4 steel cylindrical reservoirs 50 m³ each. The water enters each cylindrical reservoir by gravity from the top and exits through a cast iron pipe, 50 cm in diameter that distributes it to the villages by gravity and without any treatment. These pipes are controlled by manual vanes. There is no chlorination unit in the plant.

PHOTO 3-1: FLAOUI WTP- CONCRETE RESERVOIR

PHOTO 3-2: FLAOUI WTP- MANHOLE

PHOTO 3-3: FLAOUI WTP - CYLINDRICAL STEEL RESERVOIRS

PHOTO 3-4: FLAOUI WTP - CAST IRON PIPES

3.2.2 Plant Assessment:

The Flaoui plant is a collection and distribution plant and does not perform any water treatment. There is no one to operate or supervise this plant and it has a very bad, almost inaccessible road.

The following measures are proposed to improve this plant:

1- Carry out civil works to repair the road and make the plant accessible.
2- Build a small structure (room + toilet + kitchen) for an operator.
3- Install a chlorination unit.
4- Provide the plant with a generator of 1.4kva for lighting at night.
5- Repair the punctured HDPE pipe that was discovered during the site visit and which is causing a huge water loss.

PHOTO 3-5: FLAOUI WTP - ROAD TO THE PLANT

PHOTO 3-6: FLAOUI WTP - PUNCTURED HDPE PIPE

3.3 Baalbeck water facilities

In the caza of Baalbeck the layout of the water facilities, along with their assessment are included for 89 localities. The other 21 localities do not have any BWE facilities. Some of these villages are supplied with water from another village (in which case this will be shown on the schematics of that village), while the others rely on private wells and/or non-serviced sources or on privately acquired water. As can be seen on some of the layouts, some facilities are not connected to the system because no information could be obtained about their position relative to the other facilities.

In addition, system schematics for two major springs, namely Oyoun Orgosh and Yammoune, are included. They show the connections between the spring and the reservoirs receiving the water and distributing it to the villages. Some of the reservoirs shown on these layouts might actually be receiving water from other sources as well such as another reservoir, a well, or a local spring. In this case, the information would be depicted in the specific layout of the village where the reservoir is located. On the other hand, for some other reservoirs included on these layouts, no information could be obtained about their locations or characteristics (they are not found in the BWE database) and hence they are not included in the specific schematic of the village where they are located and they are not coded.

In the caza of Baalbeck, there are reservoirs of all sizes: 18% have a capacity of less than a 100 m^3, 7 % have a capacity larger than 2000 m^3, and 66 % have a capacity between 100 and 1000 m^3, distributed equally between the ranges 100-200 m^3; 200-500 m^3; and 500-1000 m^3 (figure 3-3). As shown in figure 3-4, 72 % of all the reservoirs (ground reservoirs and elevated tanks) were found to be in good condition, 3% need minor improvements and/or maintenance, while 22% need major rehabilitation or reconstruction. For about 3 % of the reservoirs, not enough information to conduct an assessment could be gathered. As for the wells, they are divided in two categories, namely functional and non-functional. However, a functional well may need various types of improvements to become efficient as it could be providing water intermittently or insufficiently. Overall, 25 % of the Baalbeck wells are currently non-functional (figure 3-5).

Table 3-2 lists the twenty springs identified to date in the caza of Baalbeck as being used as a water source. The minimum, maximum, and average flows for these springs are listed along with the years for which recordings are available and the entity from which the data was collected. In some instances, these recordings consist of daily measurements, for others there are monthly measurements, while for some there are only sporadic measurements. For 10 of the springs, no information whatsoever is available to date regarding the water flow. The Laboue spring in Baalbeck which has been located on the map is not listed in the table because there is no record in any of the collected documents that show it is being currently used as a water source.

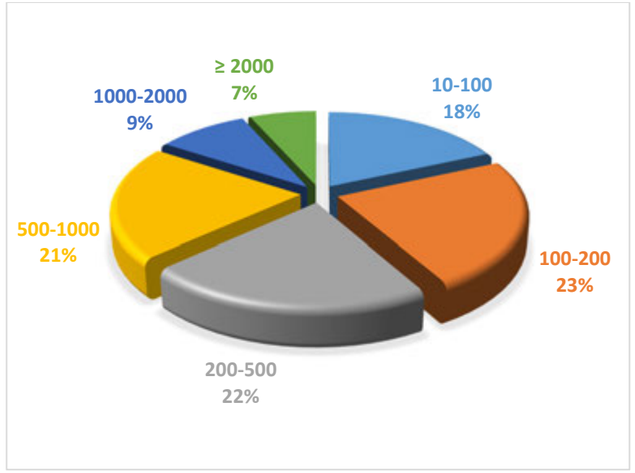


FIGURE 3-3: RESERVOIRS CAPACITY IN BAALBECK CAZA (IN M³)

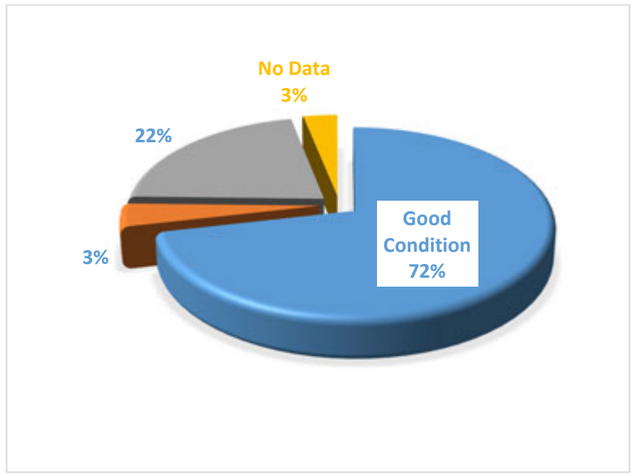


FIGURE 3-4: RESERVOIRS CONDITION IN BAALBECK CAZA

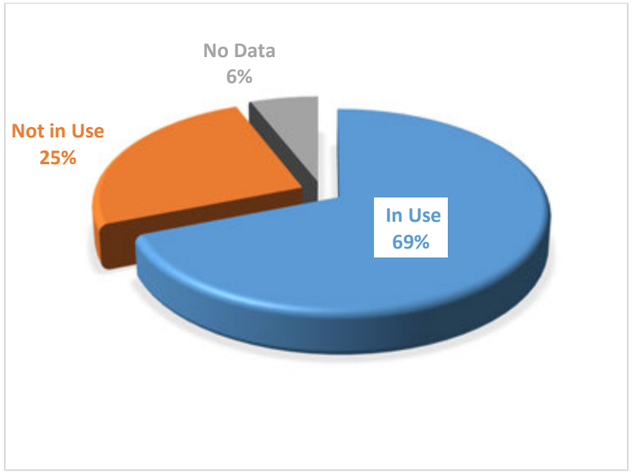


FIGURE 3-5: WELLS STATUS IN BAALBECK CAZA

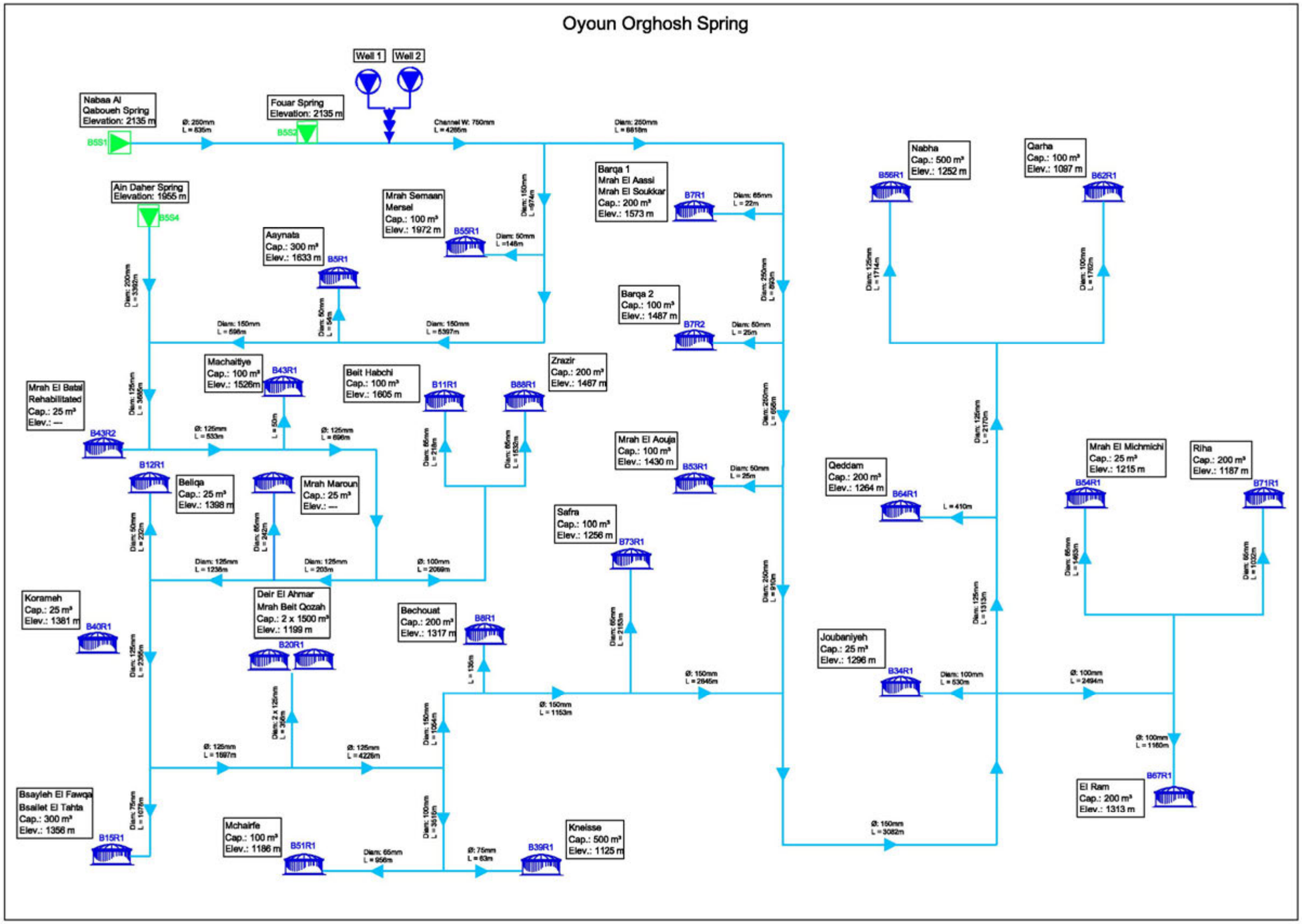
TABLE 3-2: SPRINGS IN BAALBECK CAZA

Casa	Spring name	Village	Code	Elevation	Min. Flow (l/s)	Max. Flow (l/s)	Avg. Flow (l/s)	Comments
Baalbeck	Ain Daher	Aaynata	B5S4	1955m				
	Ain el Assal		B9S1					Exact location unknown
	Ain el Debayneh		B48S1					Exact location unknown
	Ain el Delbe	Aamichki	B79S1	1549m	0.1	1.4	0.5	Not in use, based on BWE current data, Nazih Braidi (8/2010 - 1/2011)
	Ain es Sikeh	Yahfoufa	Z26S1	1163m	12	12,842	935	LRA (2002-2009)
	Chaghour	Nahle	B60S2	1573m	3.8	10		BWE database
	Derdarah	Amachiki	B1S1	1582m	0.2	1.7	0.7	Not in use, based on BWE current data, Nazih Braidi (8/2010 – 1/2011)
	El Ghale	Aaynata	B5S3					
	Fekehe	Fekehe	B22S1	1025m				
	Fouar		B5S2	2135m				Exact location unknown
	Jaouzeh	Amachiki	B1S2	1545m				Not in use, based on BWE current data
	Lajouje	Nahle	B60S1	1581m	28.6	39.5	32.6	Nazih Braidi (8/2010 - 1/2011)
					30	100		BWE database
	Nabaa al Qaboueh	Aaynata	B5S1	2135m				
	Ras el Ain	Baalbeck	B6S1		0	279	104	Exact location unknown, used only for irrigation, LRA (2009-2011)
	Sbat (Nabi Chbat)	Nabi Chbat	B30S1	1575m	16.1	20.5	18.5	Nazih Braidi (8/2010 - 1/2011)
					15	1,000		BWE database
	Yammoune- al Arbaiine	Yammoune	B10S1	1362m	5	5,000		BWE database
					0	4,370	912	LRA (2009-2011)
	Yammoune- el Moghr	Yammoune	B10S1	1359m	20	40		BWE database
					20	220	87	LRA (2009-2011)
	Yammoune- Ain el Tefaha	Yammoune	B10S1	1359m	30	80		BWE database
					0	226	63	LRA (2009-2011)
	Yammoune- Dar el Wasiaa	Yammoune	B10S1					
	Zabboud Old Spring	Zabboud	B86S1					Exact location unknown

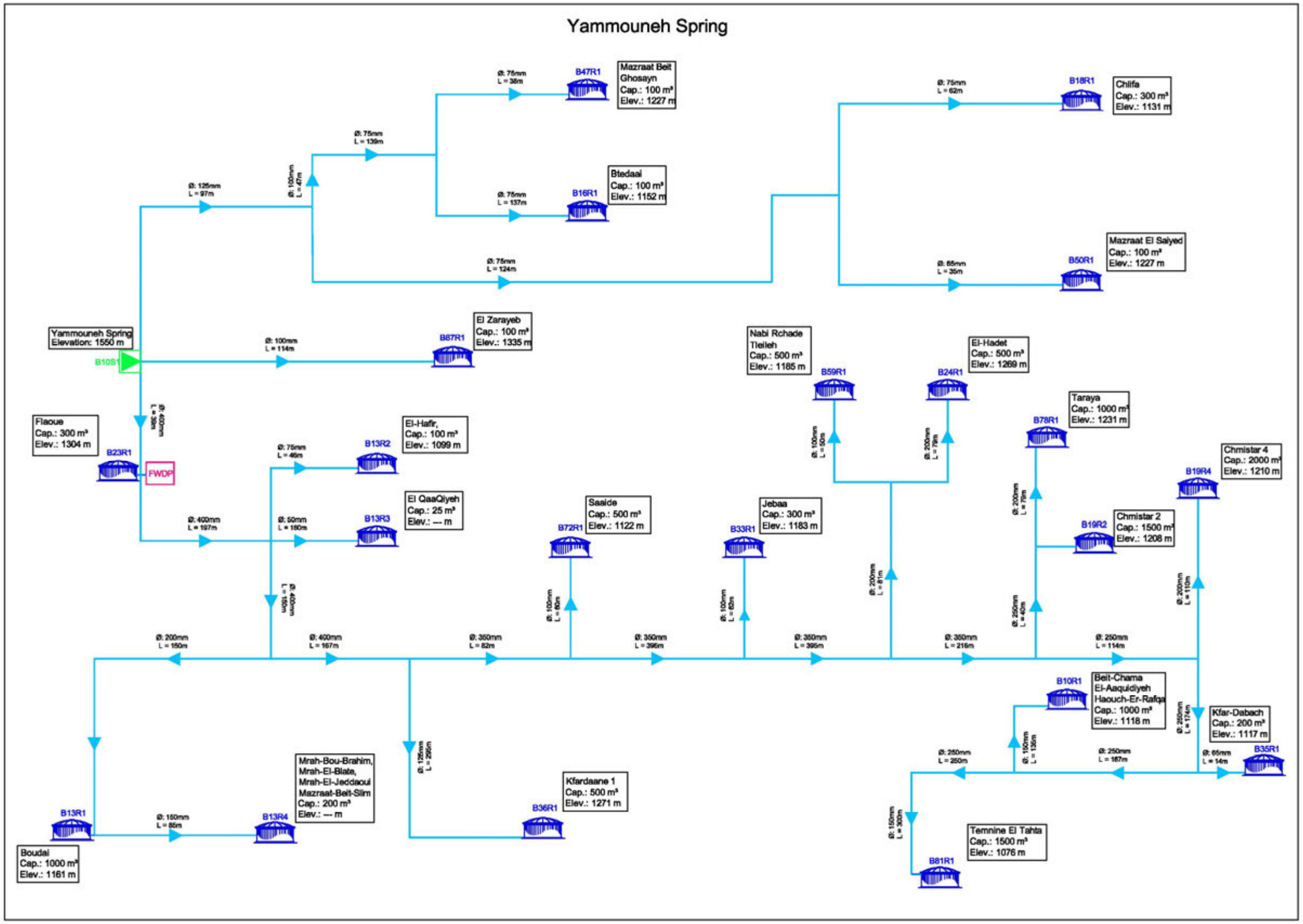
Legend:


LEGEND:
Gravity Pipe - Existing
Pressure Pipe - Existing
Pump Station - Existing
W.T.P
WTP
Well - Existing
Spring
Elevated Tank - Existing
Reservoir - Existing
CL
Chlorinator

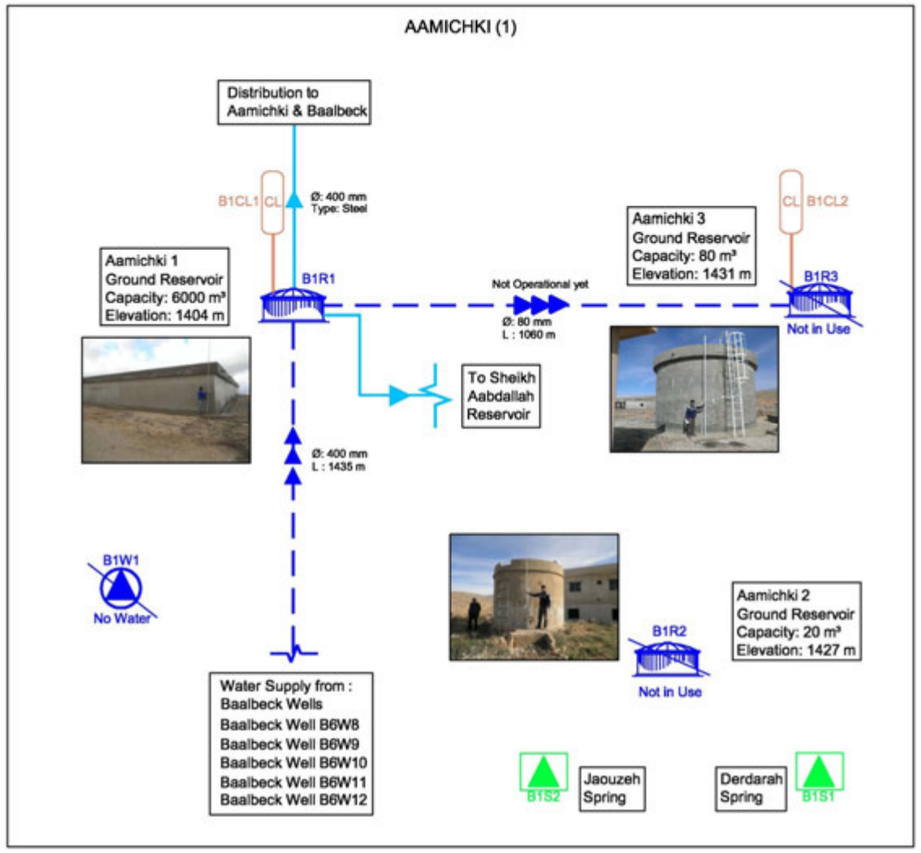
Oyoun Orgosh Spring:



Yammouneh Spring:



Aamichki (1)



There is no available information concerning the water network of the town.

Reservoir B1R1 (6000 m³): The reservoir is in good condition and supplies the water distribution network of Aamichki and Baalbeck. This reservoir is supplied from reservoir B1R2 and Baalbeck wells no. 12, 14, 16, 17, 18 and 19.

Reservoir B1R2 (20 m³): Reservoir is old and it is in bad condition. It needs esthetical and structural rehabilitation or reconstruction. This reservoir is not in use.

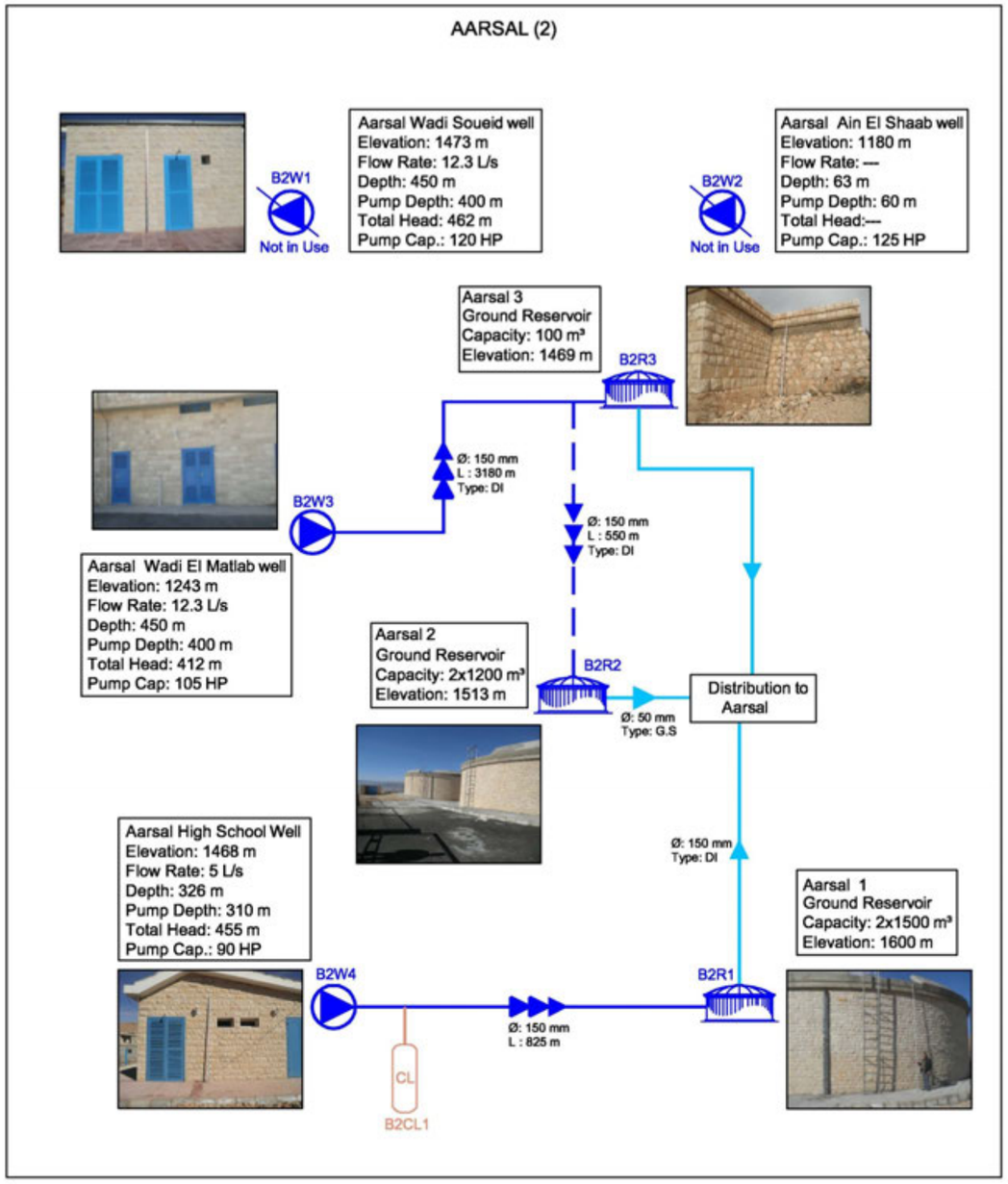
Reservoir B1R3 (80m³): Reservoir is new and it is in good condition but it is not in use yet.

Spring B1S1: No available information.

Spring B1S2: Water runs into a brick channel coming from mountains no more available information.

*Well B1*W1: It is a new well but no water was found.

Aarsal (2)



The existing water network is in very good condition and it has a length of around 98 km. It covers a large area of the town.

Well B2W1 (10 years old): The well is new and in good condition but it is not in use.

Well B2W2 (35 years old): This well is not in use.

Well B2W3 (10 years old): Access to the well room was not possible at time of survey.

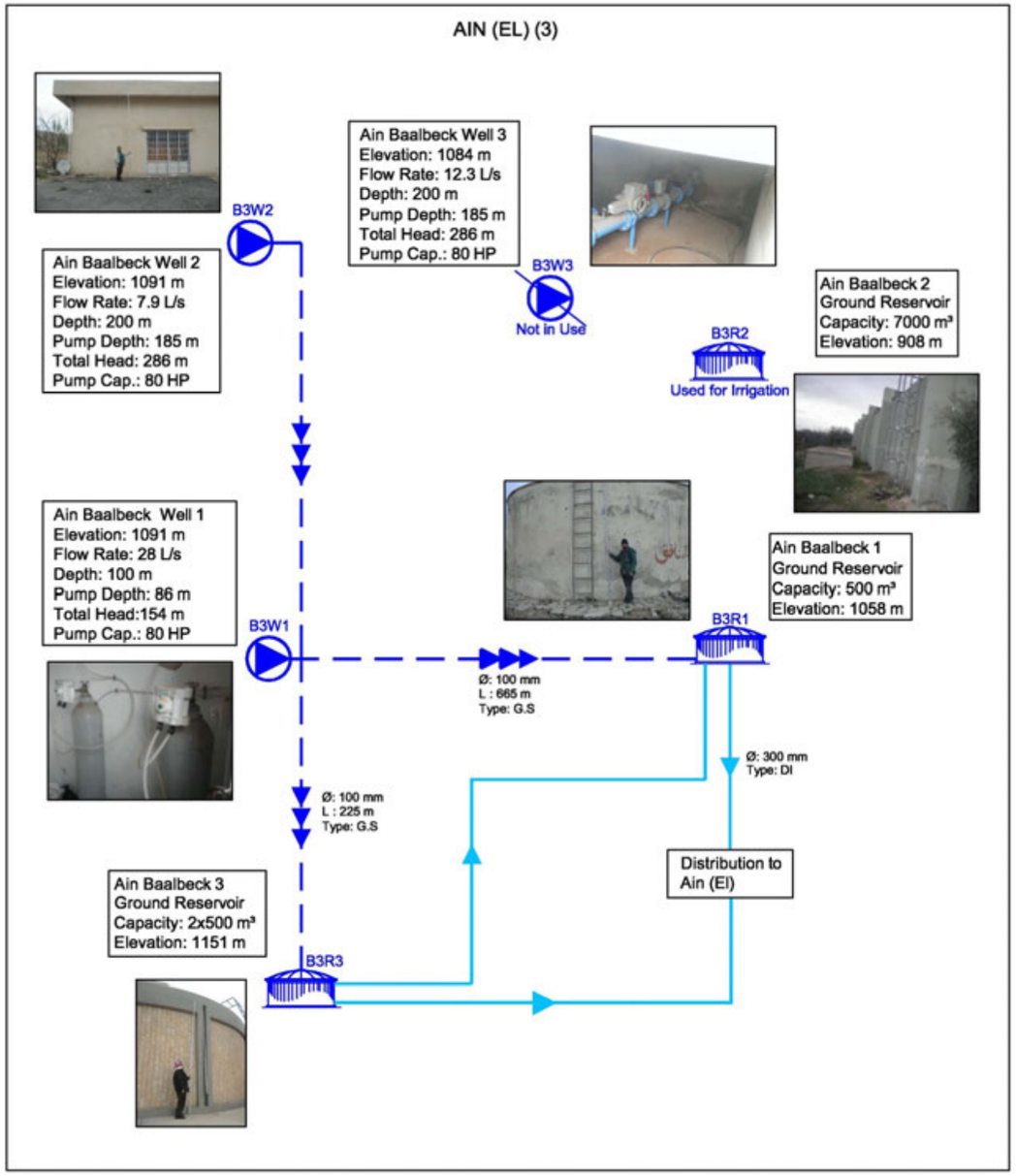
Well B2W4 (20 years old): The well is new and in good condition but it suffers from a shortage of electric power.

Reservoir B2R1 (10 years old; 2x1500 m³): Reservoir is new and it is in good condition. The pipes and valves are rusted and they need maintenance

Reservoir B2R2 (10 years old; 2x1200 m³): Reservoir is new and it is in good condition.

Reservoir B2R3 (100 m³): Reservoir is old and it is in bad condition. It needs esthetical and structural rehabilitation or reconstruction.

Ain (El) (3)



The existing water network is in very good condition and it has a length of around 46 km. It covers a large area of the town.

Well B3W1 (<40 years): Well suffers from a shortage of electric power. A chlorination room with equipment is present and operational. This well is old but it is in acceptable condition.

Well B3W2 (>10 years): It has a chlorination room and a power generator. This well is in good condition.

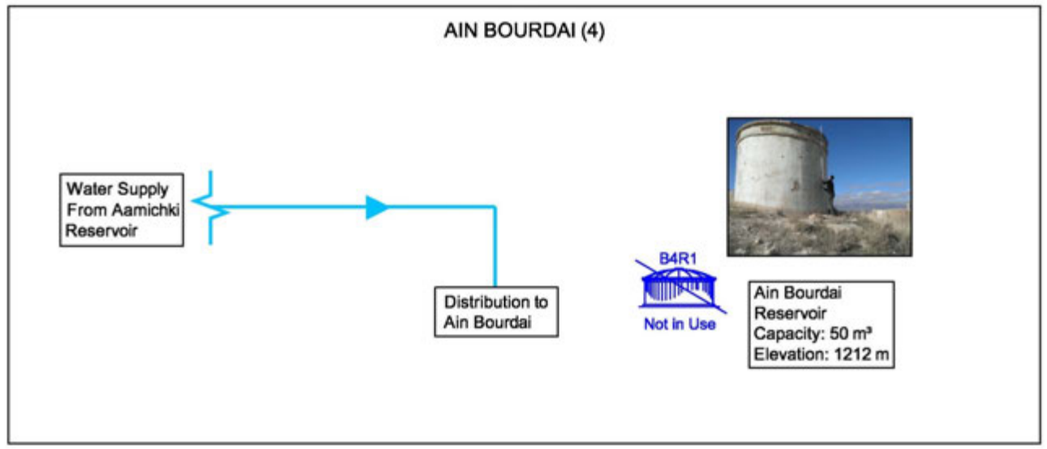
Well B3W3 (15 years old): This well is located in Aarsal region. It shares the same power generator with well b3w2. It is a standby well and it is not operational. This well is in good condition.

Reservoir B3R1 (40 years old; 500m³): Reservoir is old and needs rehabilitation. The pipes and valves are rusted and they need maintenance

Reservoir B3R2 (7000m³): Reservoir is in good condition. It is open-top reservoir and is mainly used for irrigation. Water source is unknown but it is more probably from rainwater.

Reservoir B3R3 (>10 years; 2x500m³): Reservoir is new and it is in good condition.

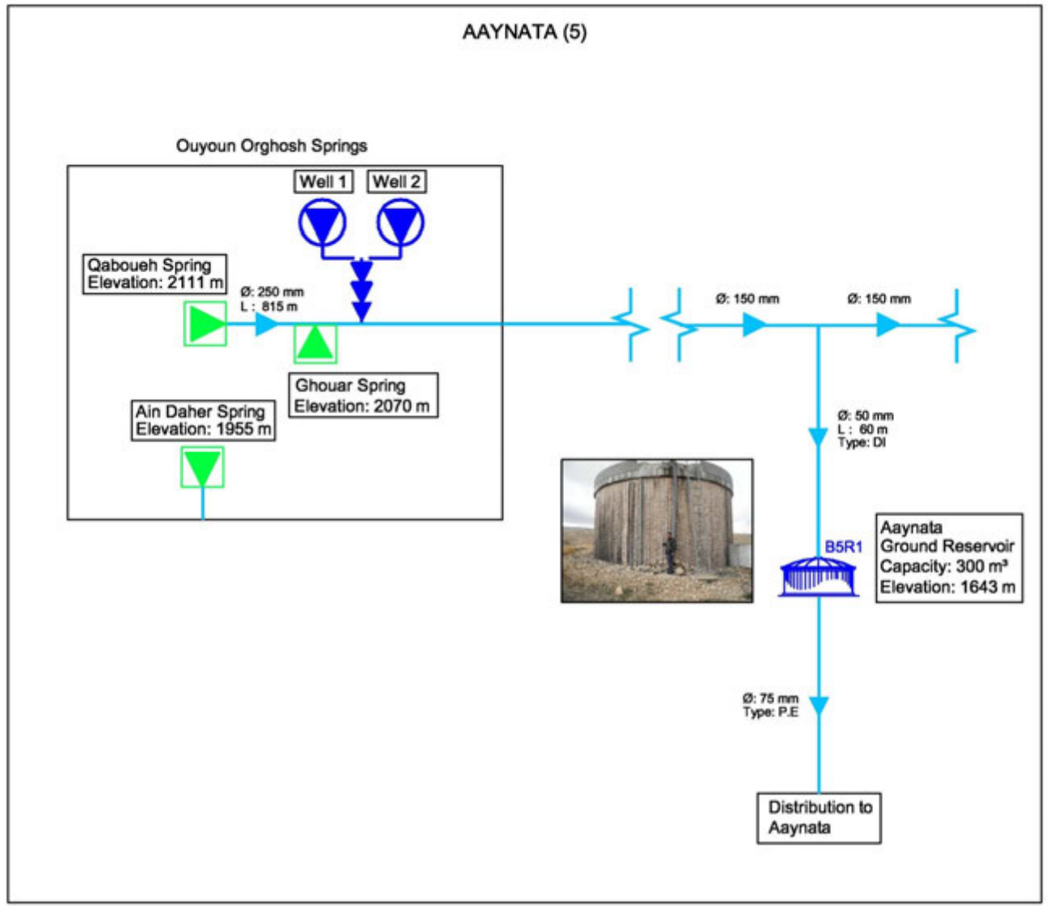
Ain Bourdai (4)



The existing water network is in very good condition and it has a length of around 15 km. It covers a large area of the town.

Reservoir B4R1 (50m³): Reservoir is old and is not in use. It needs structural rehabilitation or reconstruction.

Aaynata (5)

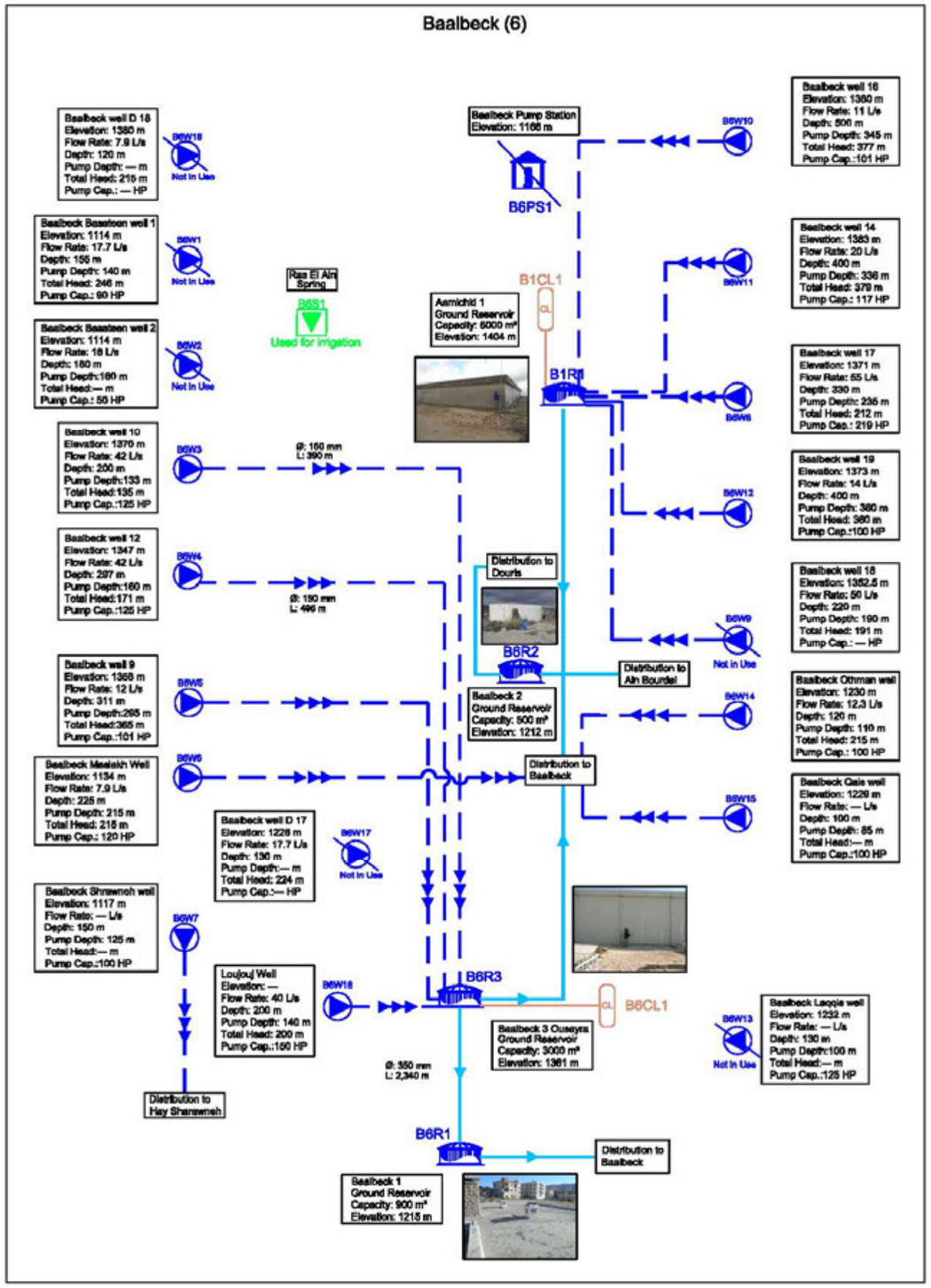


The existing water network is in bad condition and it has a length of around 14 km. It covers a large area of the town.

Ouyoun Orghosh Spring: It consists of al Qaboueh Spring, Ghouar Spring, and Ain Daher Spring. These springs are supplying water to many villages in the Baalbeck caza.

Reservoir B5R1 (300 m³): Reservoir is in bad condition. It needs esthetical and structural rehabilitation.

Baalback (6)



The existing water network is in very good condition and it has a length of around 268 km. It covers a large area of the town.

Well B6W1 (>15 years): Well is old and it is not in use anymore.

Well B6W2 (5 years old): Well is new but it is not in use yet.

Well B6W3 (>15 years): Well is new. It supplies reservoir B6R3 and the distribution network of Baalbeck. Its valve chamber is subject to leakage and needs maintenance.

Well B6W4 (>15 years): Well is new.

Well B6W5 (>15 years): Well is in good condition and it supplies reservoir B6R3.

Well B6W6 (>15 years): Well directly supplies the distribution network of Baalbeck.

Well B6W7 (>15 years), B6W10 (>15 years), & B6W11 (>15 years): No information available.

Well B6W8 (>15 years): It suffers from a shortage of electric power. No more available information.

Well B6W9, B6W13, B6W17 (>10 years), & B6W18: Well is not in use.

Well B6W12 (>15 years): Well is in good condition.

Well B6W14: Well is in good condition and it directly supplies the distribution network of Baalbeck.

Well B6W15: Well is in good condition and it directly supplies the distribution network of Baalbeck.

Well B6W16 (≤5 years old): This well is new. No more available information.

Pump station B6PS1: Pump station is old and it is not in use.

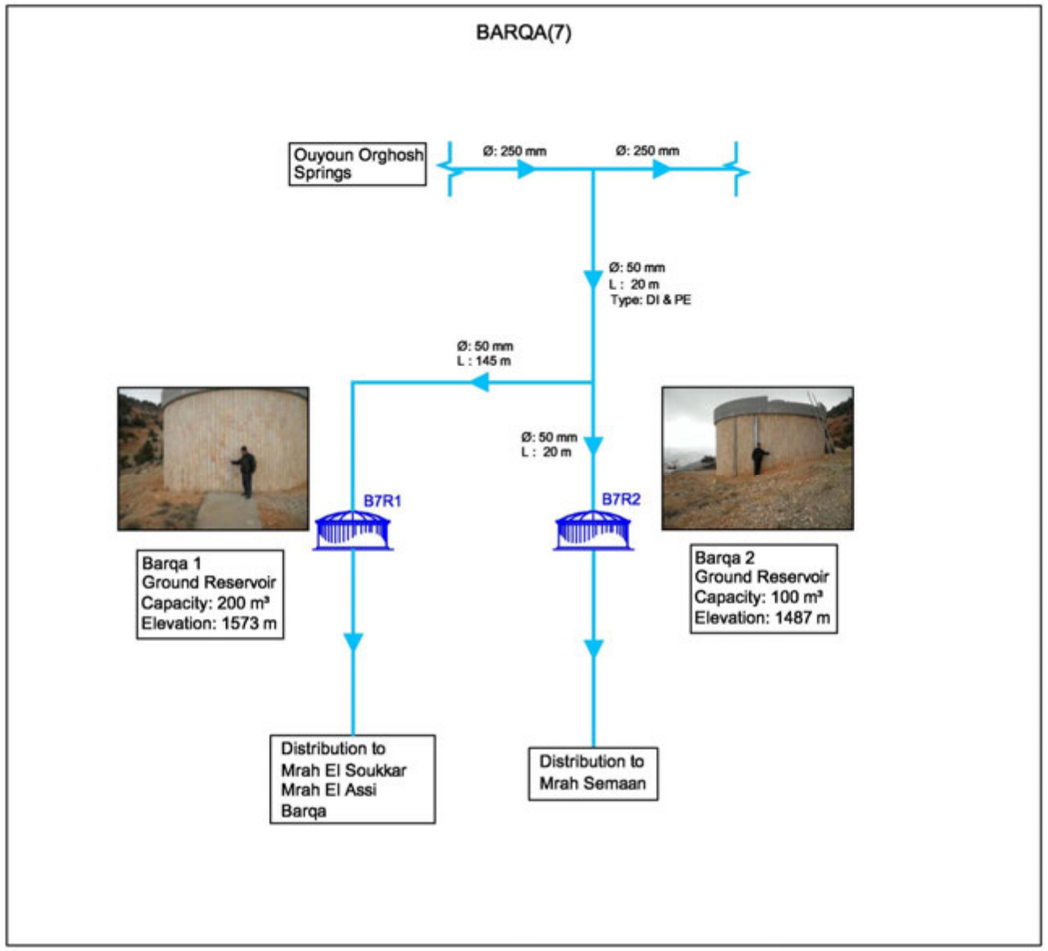
Spring B6S1: Spring is used only for irrigation.

Reservoir B6R1 (900m³): Reservoir is in good condition. The pipes and valves are rusted and they need maintenance.

Reservoir B6R2 (500m³): Reservoir is in bad condition. It needs esthetical and structural rehabilitation.

Reservoir B6R3 (<10 years; 3000m³): Reservoir is in good condition.

Barqa (7)

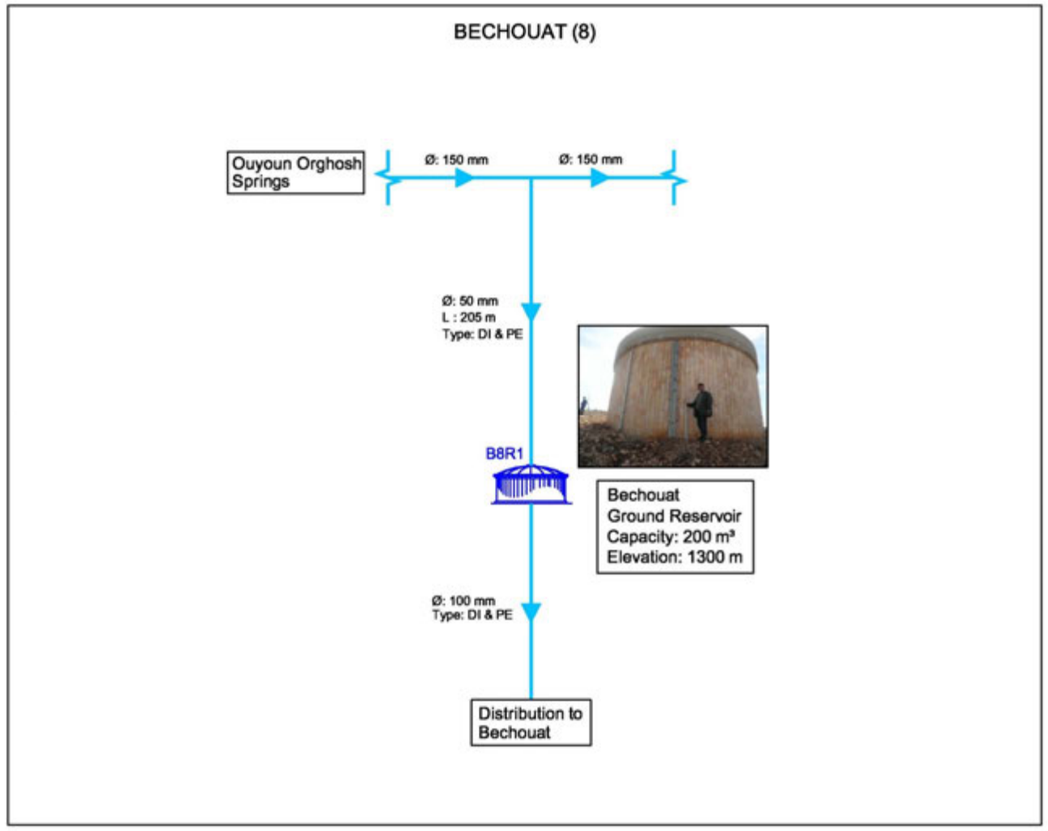


The existing water network is in bad condition and it has a length of around 4.3 km. It covers a very small part of the town.

Reservoir B7R1 (>10 years; 200m³): Reservoir is in good condition.

Reservoir B7R2 (100m³): No available information.

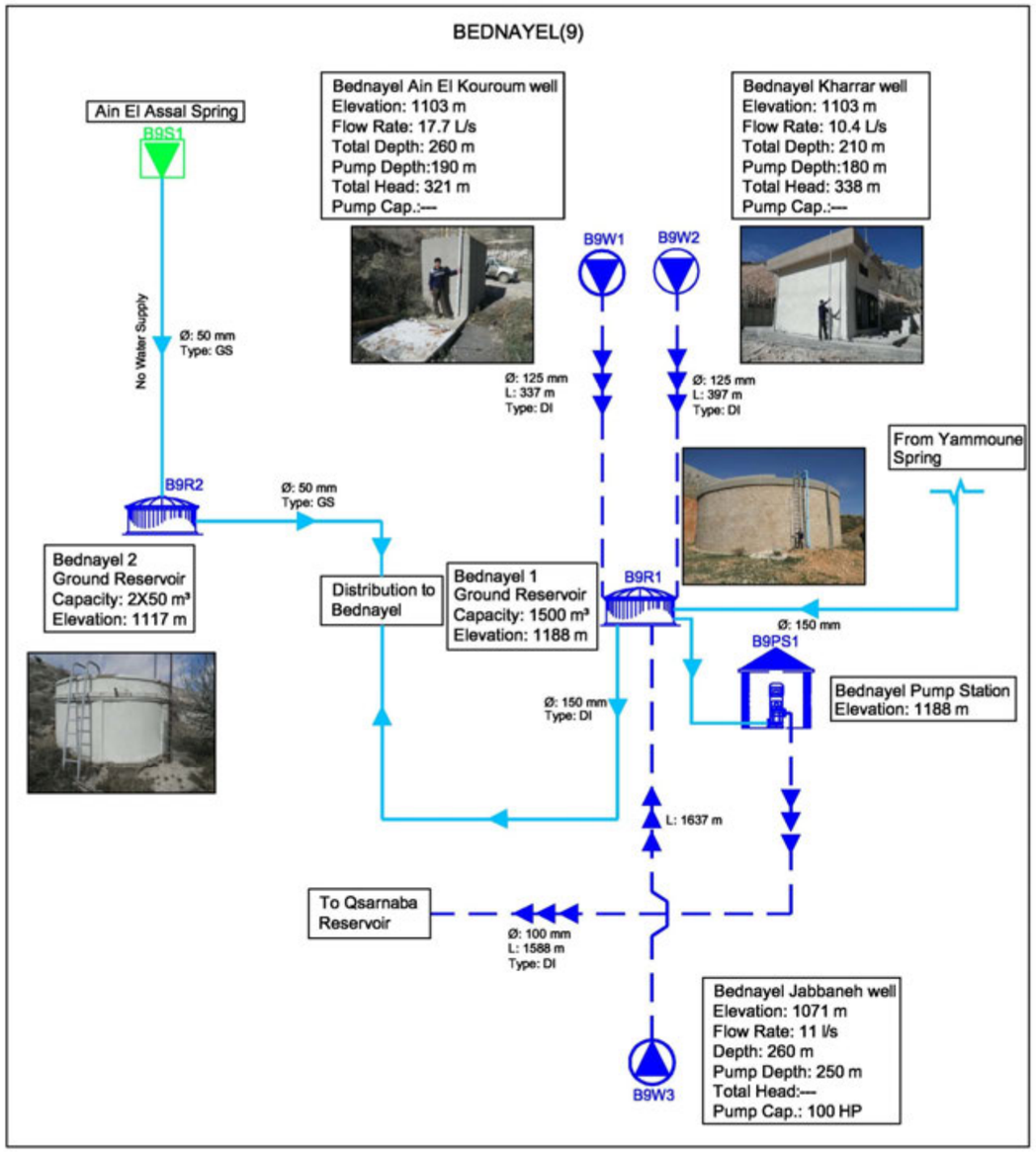
Bechouat (8)



The existing water network is in medium condition and it has a length of around 17 km. It covers a part of the town.

Reservoir B8R1 (>10 years; 200m³): Reservoir is in good condition. Its valve chamber is subject to leakage. This reservoir needs minor maintenance.

Bednayel (9)



The existing water network is in very good condition and it has a length of around 26.3 km. It covers a large area of the town.

Well B9W1 (>15 years): Well is in good condition but it suffers from a shortage of electric power. There is a chlorination unit for this well but it is still under construction.

Well B9W2 (>10 years): Well is in good condition but it suffers from pump ignition problems and needs maintenance.

Well B9W3 (>20 years): No available information.

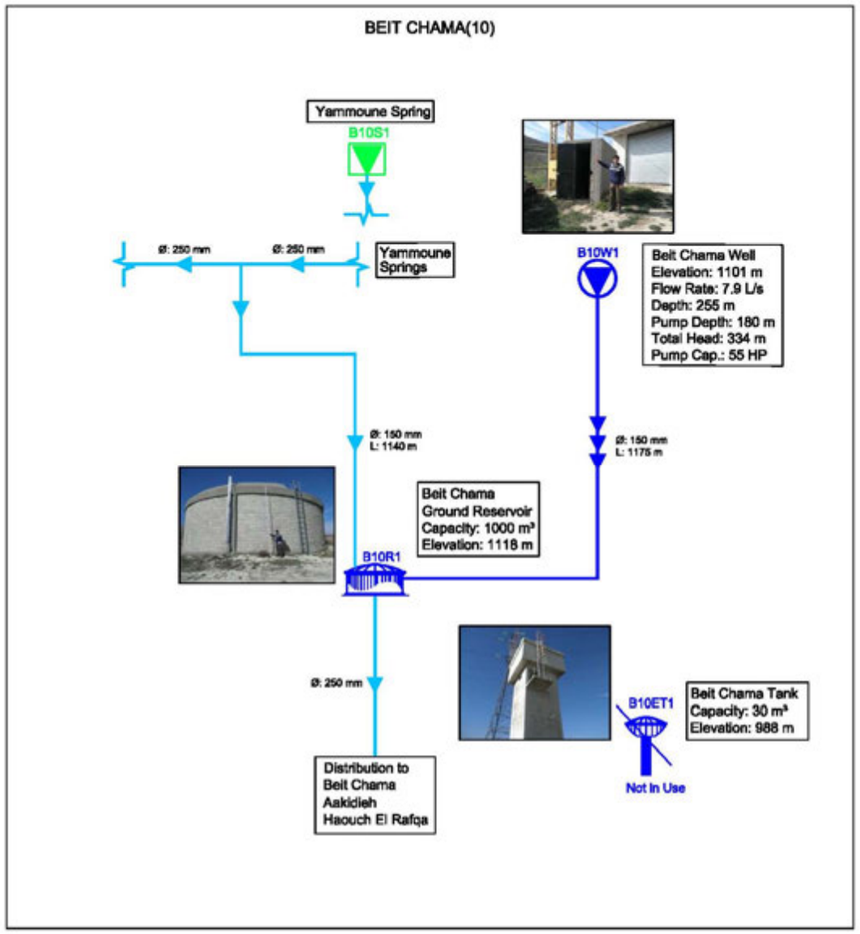
Spring B9S1: No available information.

Pump station B9PS1: Pump is within the reservoir control room. It is in good condition.

Reservoir B9R1 (>10 years; 1500m³): Reservoir is in good condition and it has a chlorinator unit.

Reservoir B9R2 (2x50 m³): Reservoir is in an acceptable condition and it needs esthetical rehabilitation.

Beit Chama (10)



The existing water network is in very good condition and it has a length of around 15 km. It covers a large area of the town.

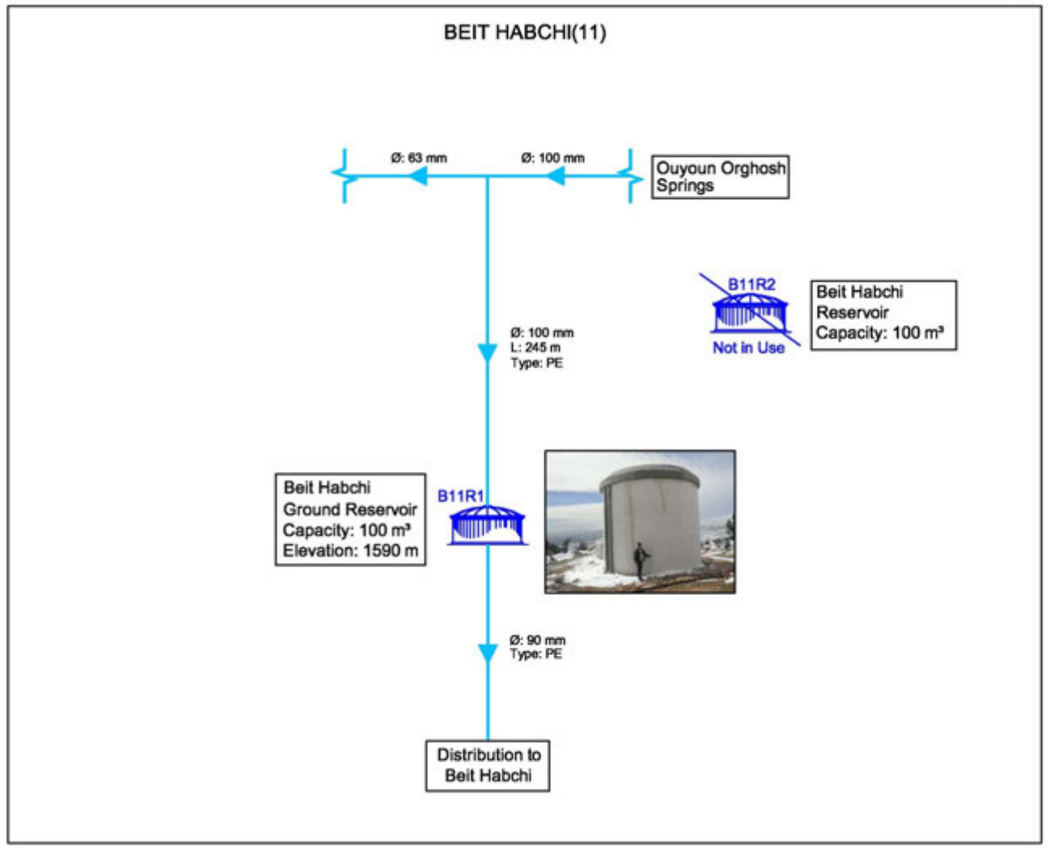
Well B10W1 (15 years old): Well is in good condition but it suffers from a shortage of electric power.

Spring B10S1: Spring is connected to Dar El Wasaa station, and it is supplying many villages. The water surplus for this spring is used for irrigation purposes. No information available.

Reservoir B10R1 (>10 years; 1000 m³): Reservoir is in good condition and is equipped with a chlorination chamber, but its tanks are empty.

Elevated tank B10ET1 (30 m³): Tank is in an acceptable condition but it is not connected to the distribution network. It is not in use.

Beit Habchi (11)

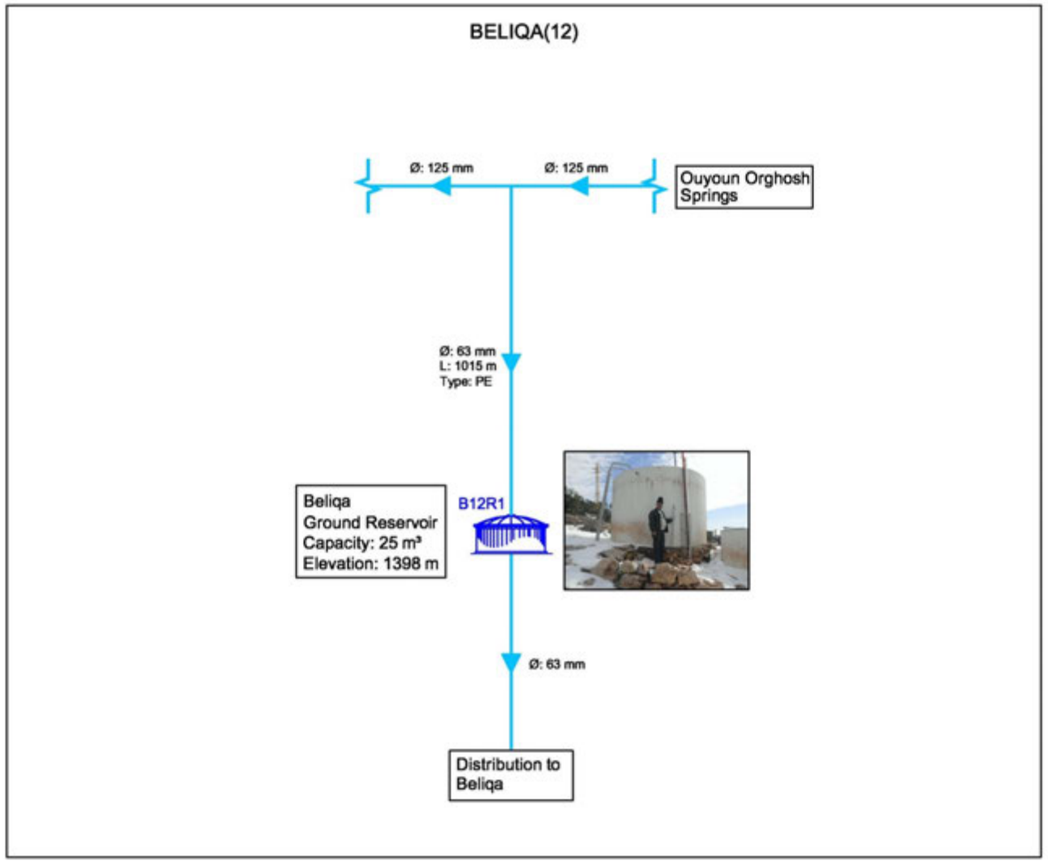


There is no available information concerning the water network of the town.

Reservoir B11R1 (100m³): Reservoir is in good condition.

Reservoir B11R2 (100 m³): Reservoir is not in use.

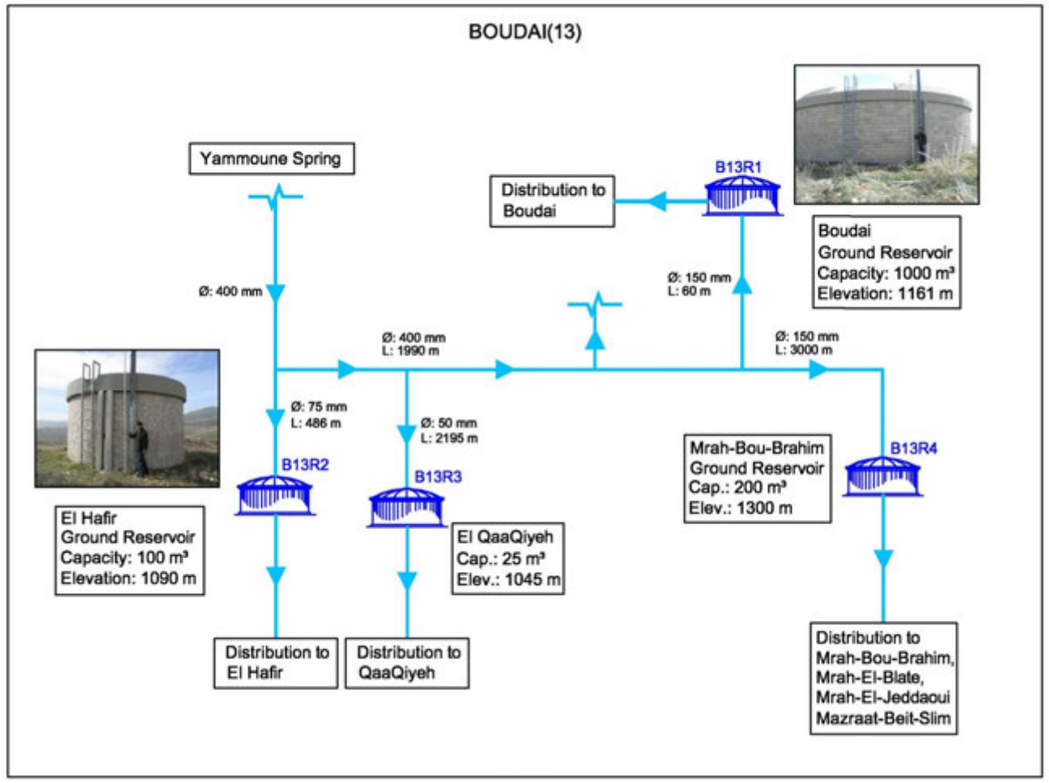
Beliqa (12)



The existing water network is in very good condition and it has a length of around 1 km. It covers a large area of the town.

Reservoir B12R1 (25 m³): Reservoir is in bad condition and needs esthetical and structural rehabilitation or reconstruction. The pipes and valves are rusted and they need maintenance

Boudai (13)



The existing water network is in good condition and it has a length of around 44 km. It covers a part of the town.

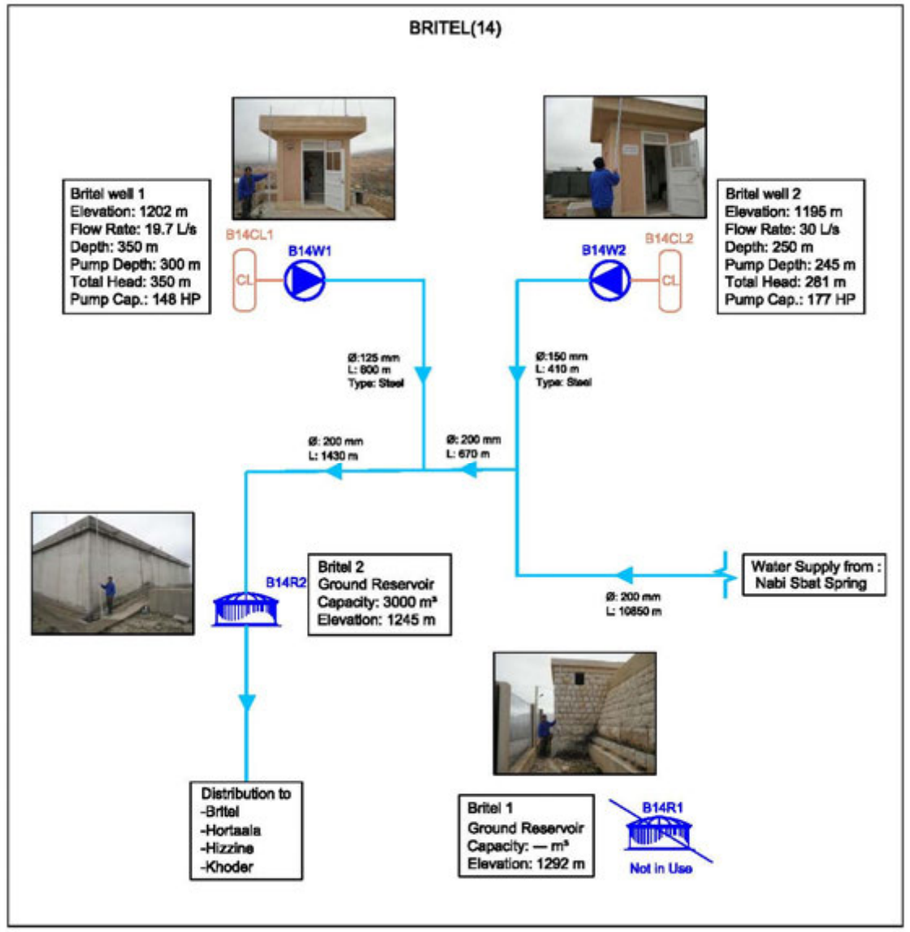
Reservoir B13R1 (>10 years; 1000 m³): Reservoir is in good condition.

Reservoir B13R2 (100 m³): Reservoir is in good condition.

Reservoir B13R3 (>10 years; 25m³): No information available.

Reservoir B13R4 (200m³): No information available.

Britel (14)



The existing water network is in very good condition and it has a length of around 103 km. It covers a large area of the town.

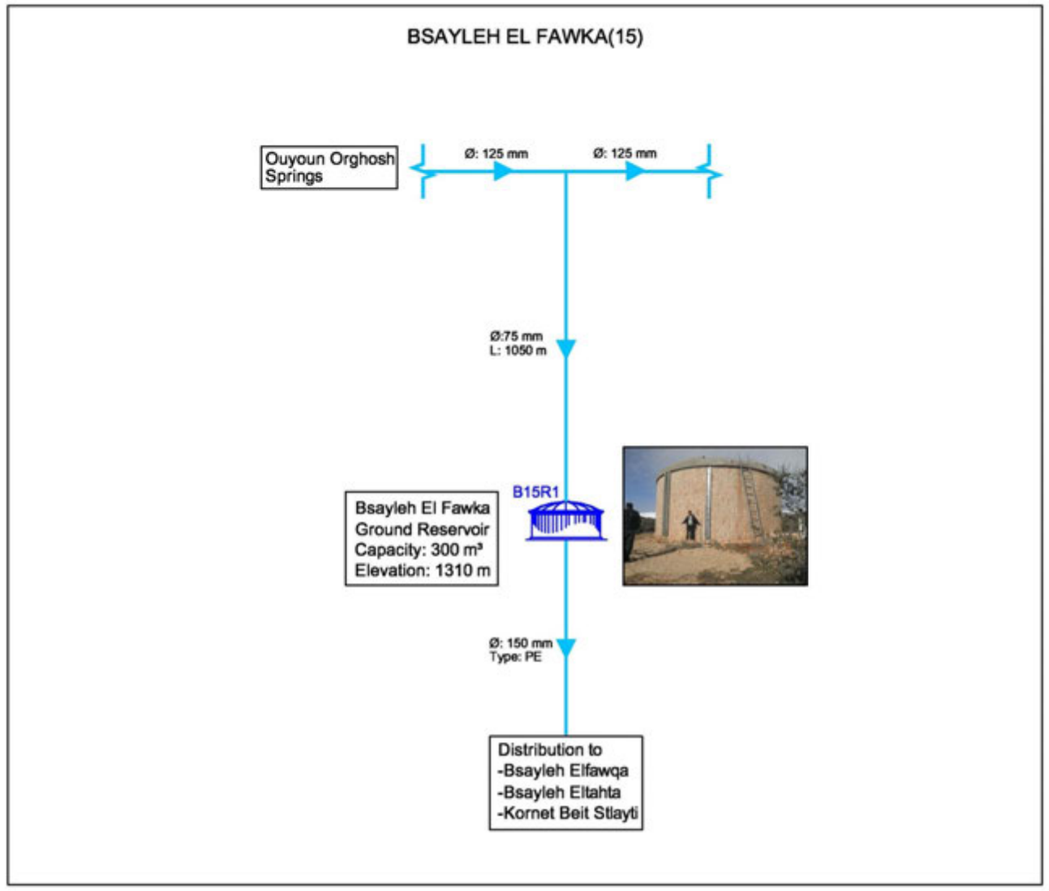
Well B14W1 (>15 years): Well is in good condition and is equipped with a chlorination chamber. It suffers from a shortage of electric power.

Well B14W2 (>15 years): Well is in good condition and is equipped with a chlorination chamber.

Reservoir B14R1: Reservoir is not accessible and it is not in use.

Reservoir B14R2 (3000 m³): Reservoir is in good condition.

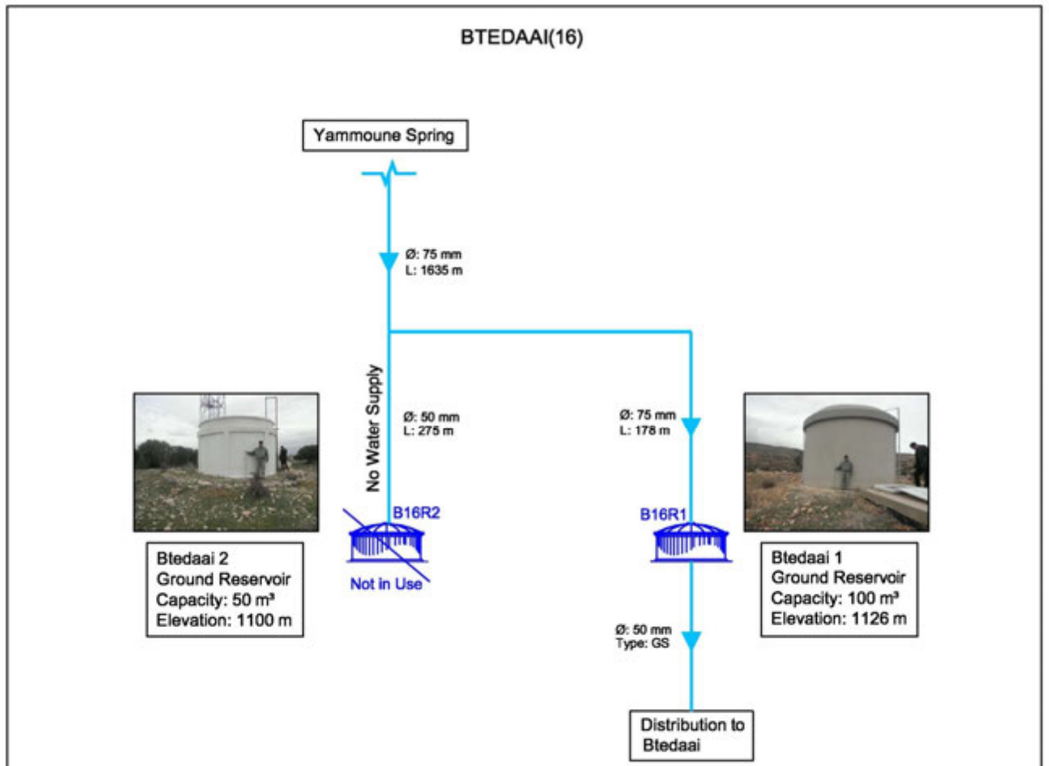
Bsayleh el Fawka (15)



There is no available information concerning the water network of the town.

Reservoir B15R1 (300m³): Reservoir is in good condition.

Btedaai (16)

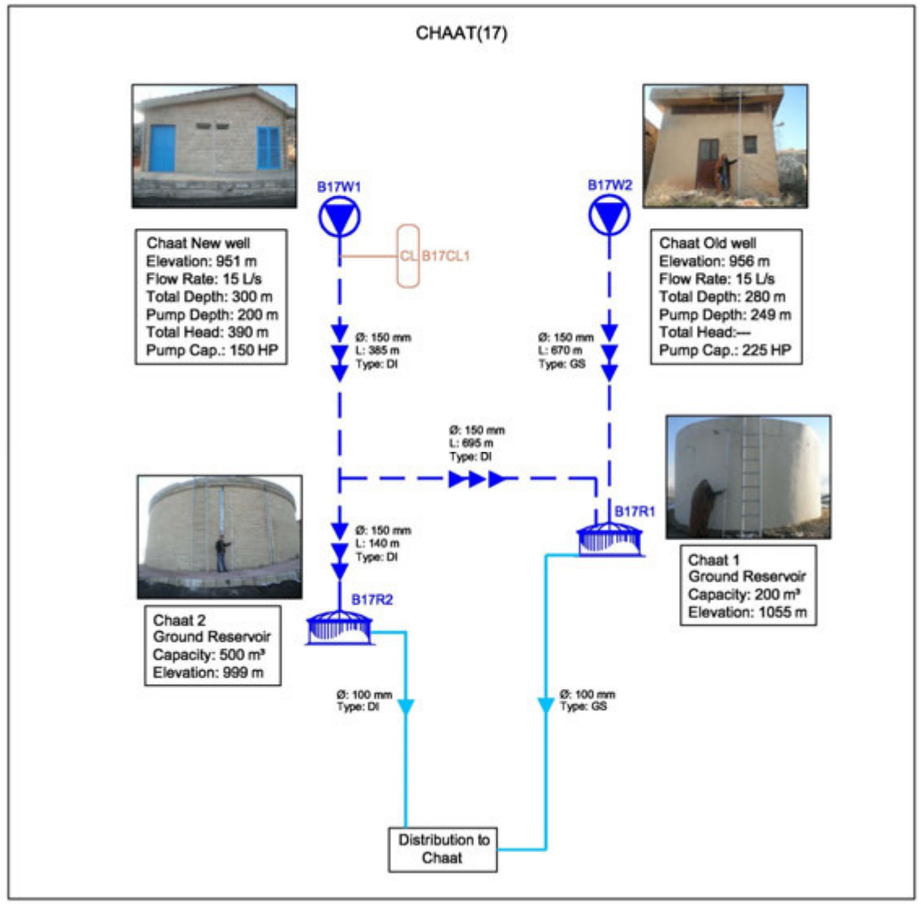


The existing water network is in bad condition and it has a length of around 7.3 km. It covers a part of the town.

Reservoir B16R1 (>10 years; 100 m³): Reservoir is in good condition.

Reservoir B16R2 (50 m³): Reservoir is in good condition but it is not currently in use. The inlet and outlet pipes are unfilled with water but there is no available information concerning their conditions.

Chaat (17)



The existing water network is in bad condition and it has a length of around 19.6 km. It covers a part of the town. It is under maintenance by the municipality.

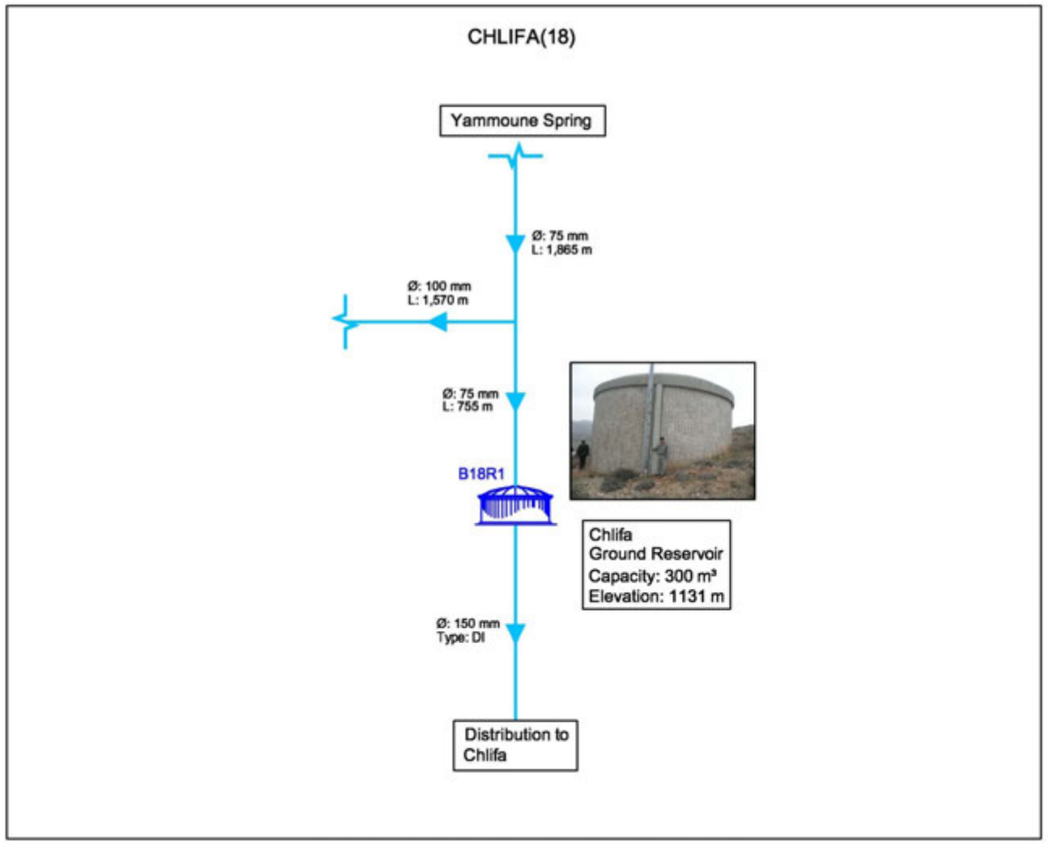
Well B17W1 (5 years old): Well is in good condition but it suffers from a shortage of electric power. It supplies reservoir b17r2 and is equipped with a chlorination chamber, though not operational.

Well B17W2 (>25 years): Well is in good condition and it supplies reservoir B17R1.

Reservoir B17R1 (>40 years; 200 m³): Reservoir is in bad condition and needs esthetical and structural rehabilitation or reconstruction. The pipes and valves are rusted and they need maintenance.

Reservoir B17R2 (5 years old; 500 m³): Reservoir is in good condition.

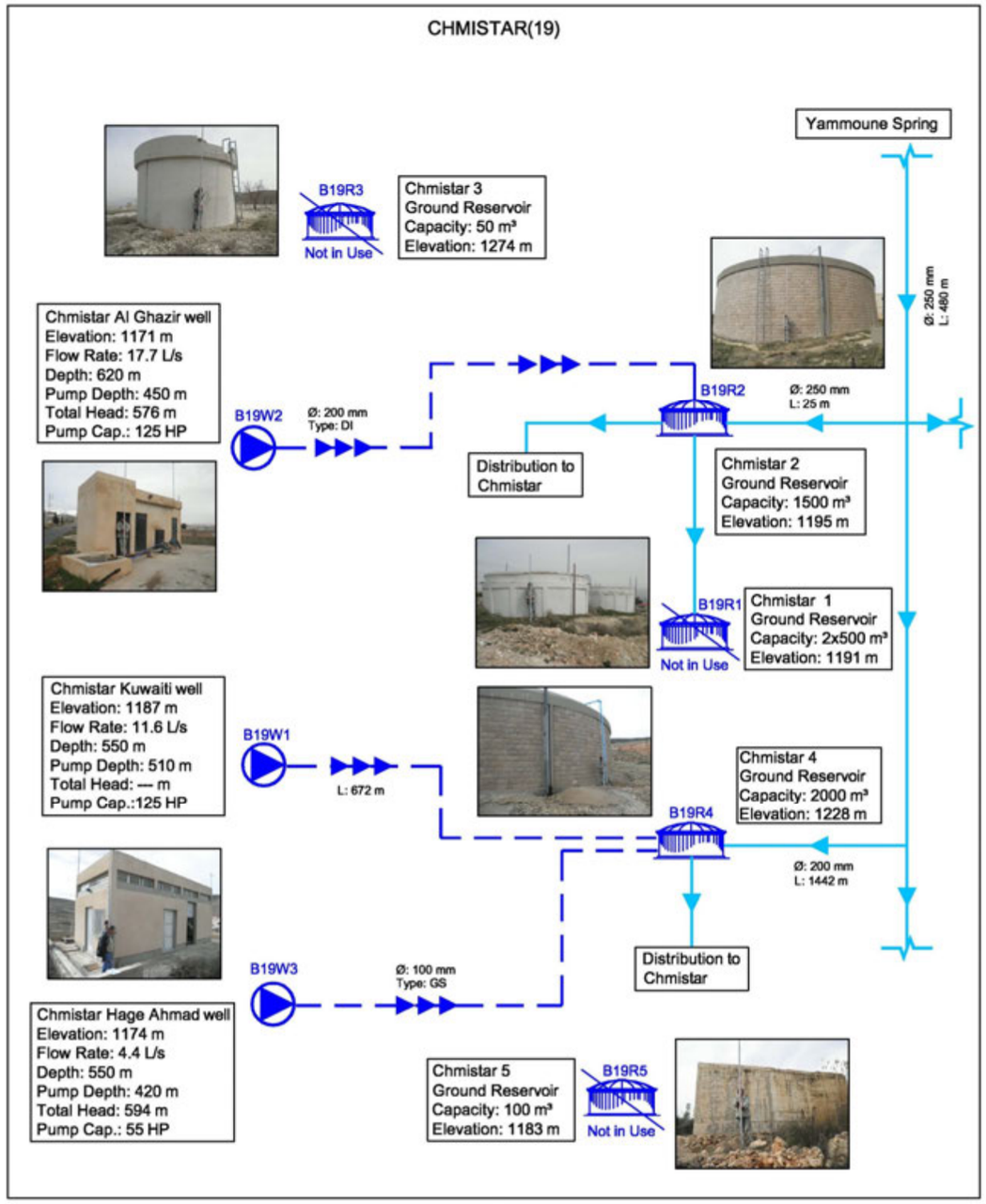
Chlifa (18)



The existing water network is in very good condition and it has a length of around 9.3 km. It covers a large area of the town.

Reservoir B18R1 (>10 years; 300 m³): Reservoir is in good condition.

Chmistar (19)



The existing water network is in bad condition and it has a length of around 55 km. It covers a large area of the town.

Well B19W1 (>5 years): Well is in good condition.

Well B19W2 (>15 years): Well is in good condition and is equipped with a chlorination chamber.

Well B19W3 (>25 years): Well is old but it is in good condition. It suffers from a shortage of electric power.

Reservoir B19R1 (2x500 m³): Reservoir is in good condition but it is not in use.

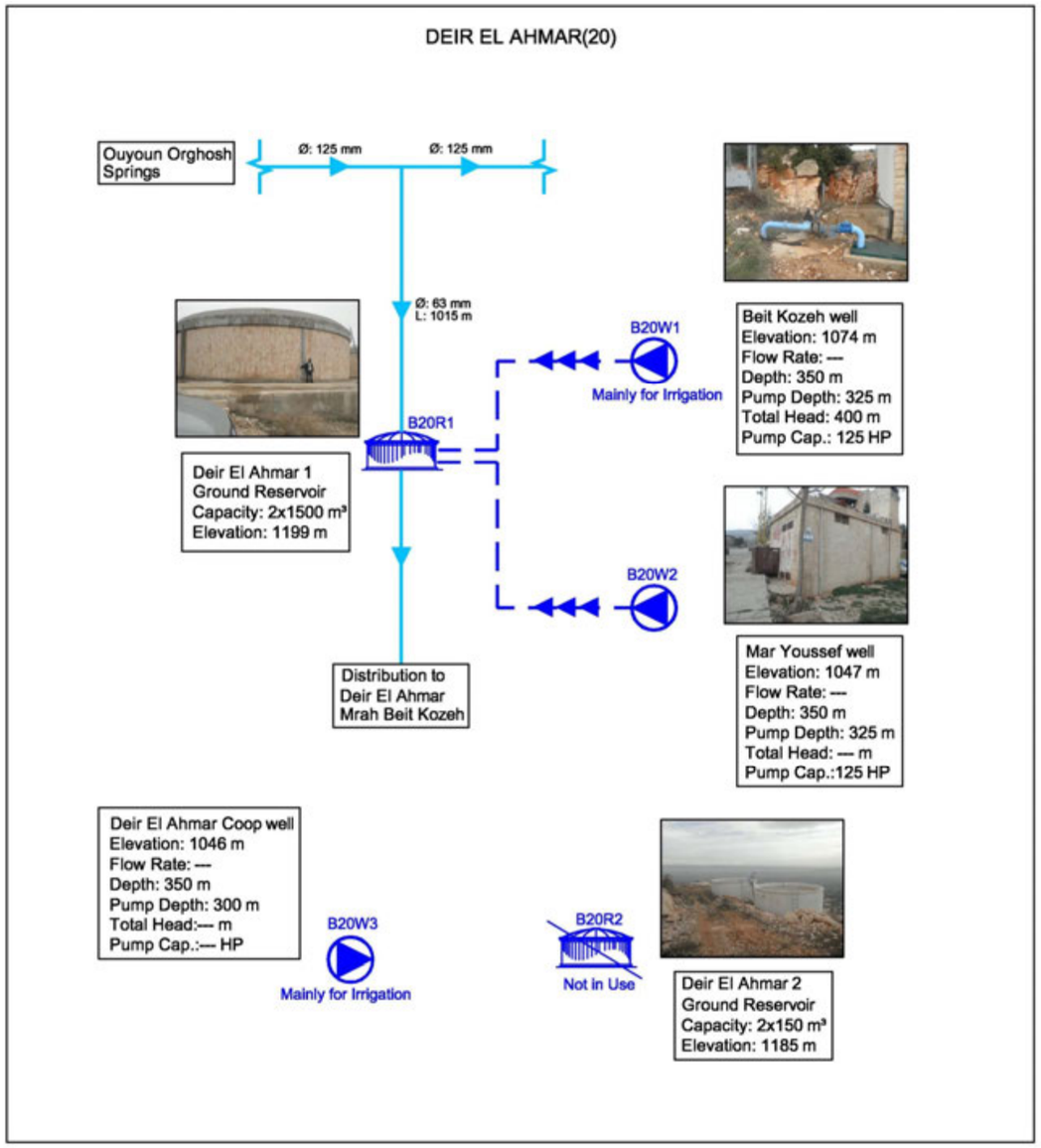
Reservoir B19R2 (>10 years; 1500 m³): Reservoir is in good condition.

Reservoir B19R3 (50 m³): Reservoir is in good condition but it is not currently in use because water does not reach it.

Reservoir B19R4 (>10 years; 2000 m³): Reservoir is in good condition.

Reservoir B19R5 (100m³): Reservoir is in bad condition and needs esthetical and structural rehabilitation or reconstruction. The pipes and valves are rusted and they need maintenance. This reservoir is not in use.

Deir El Ahmar (20)



The existing water network is in medium condition and it has a length of around 35 km. It covers a part of the town.

Well B20W1 (>15 years): Well is in good condition but it suffers from a shortage of electric power. It is used mainly for irrigation purposes only but the booster pump is currently damaged.

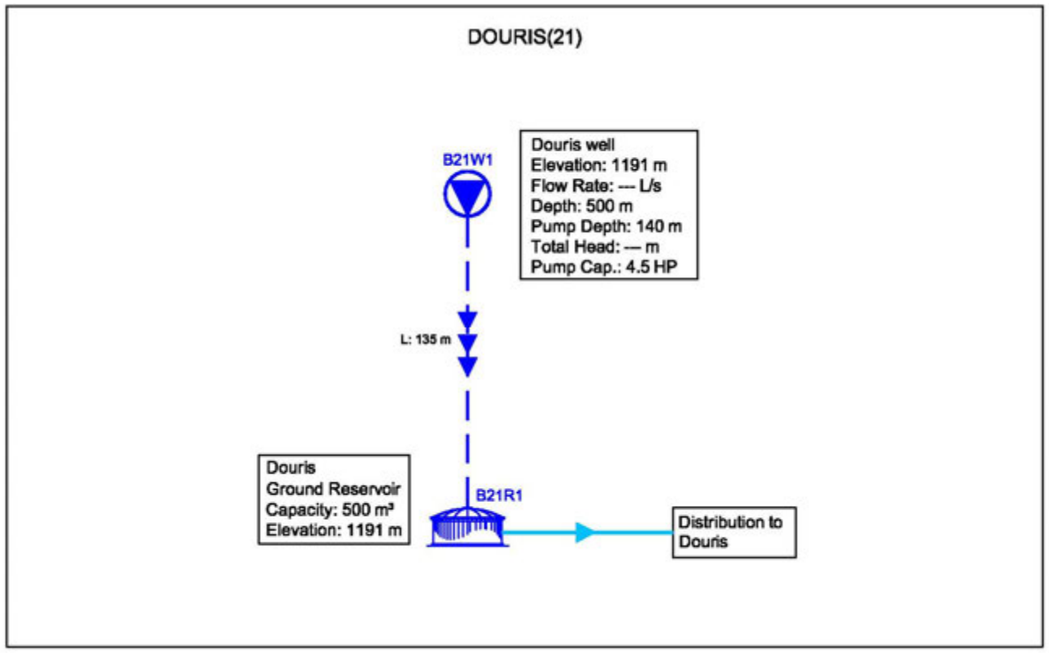
Well B20W2 (>20 years): Well has not been in use for 4 years and booster pump is damaged. A new pump shall be installed.

Well B20W3 (>30 years): Well is operated by a coop and it suffers from a shortage of electric power. It is used mainly for irrigation purposes.

Reservoir B20R1 (2x1500 m³): Reservoirs are in good condition.

Reservoir B20R2 (2x150 m³): Reservoirs are in bad condition and not in use anymore. It needs esthetical and structural rehabilitation or reconstruction. The pipes and valves are rusted and they need maintenance.

Douris (21)

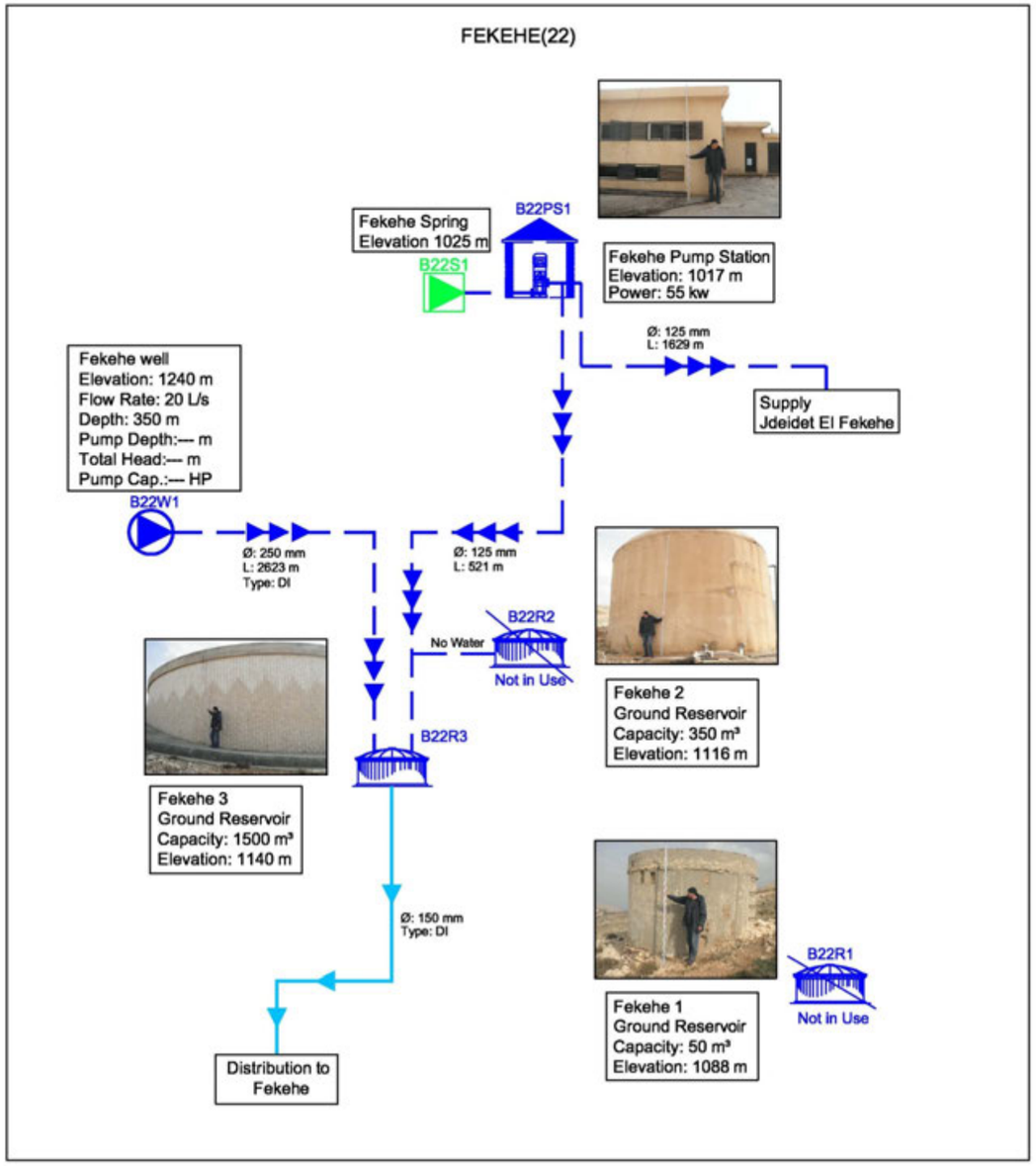


The existing water network is in good condition and it has a length of around 49 km. It covers a part of the town.

Well B21W1 (>10 years): Well is in good condition.

Reservoir B21R1 (500 m³): Reservoir is new and it is in good condition.

Fekehe (22)



The existing water network is in good condition and it has a length of around 49.3 km. It covers a large area of the town.

Well B22W1 (5 years old): Well is new and in good condition.

Pump station B22PS1: Station is in good condition.

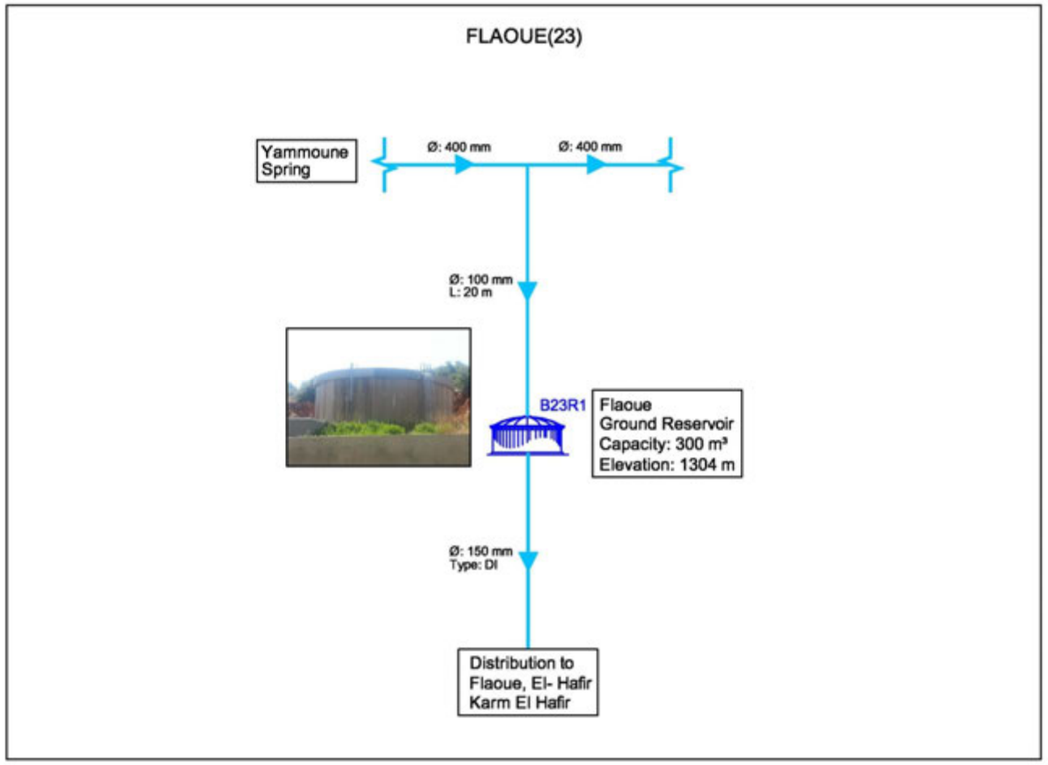
Spring B22S1: This spring supply Fekehe new ground reservoir and it is used also for irrigation. No available information.

Reservoir B22R1 (>60 years; 50 m³): Reservoir is very old and it is not in use. It needs esthetical and structural rehabilitation or reconstruction. The pipes and valves are rusted and they need maintenance.

Reservoir B22R2 (>10 years; 350 m³): Reservoir is old and it is not in use anymore.

Reservoir B22R3 (>5 years; 1500 m³): Reservoir is in good condition.

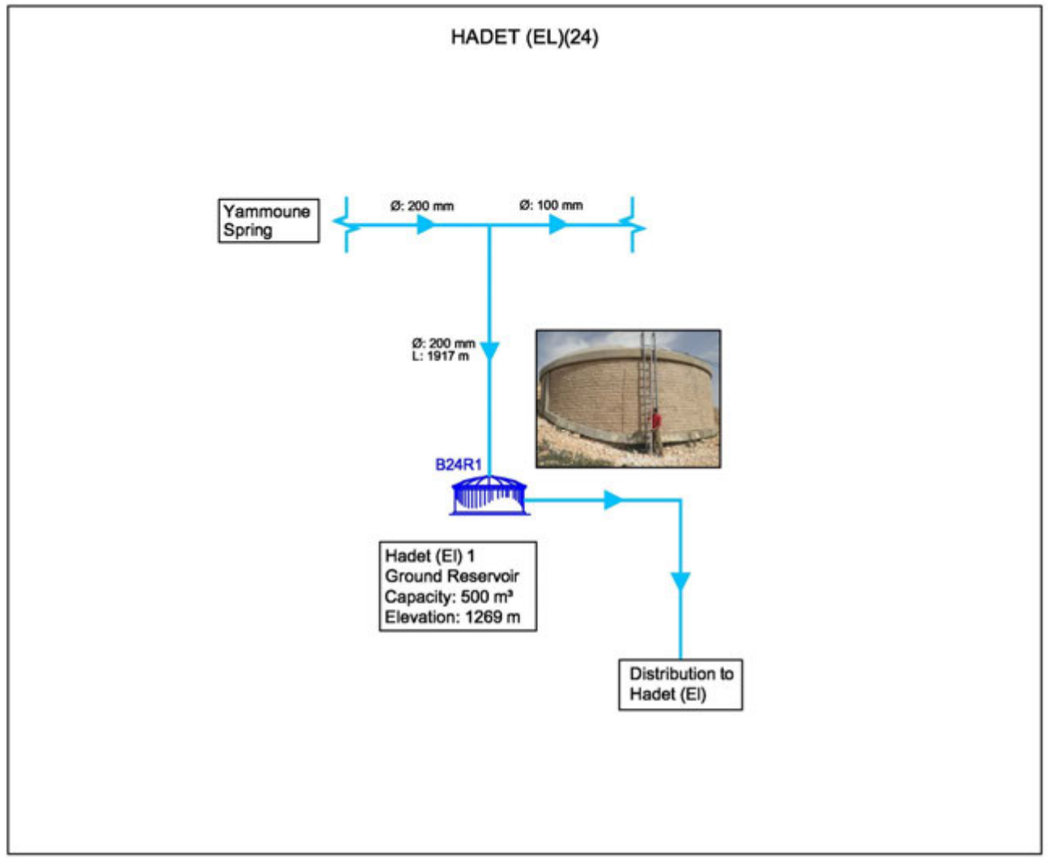
Flaoue (23)



The existing water network is in very good condition and it has a length of around 9 km. It covers a large area of the town.

Reservoir B23R1 (>10 years; 300 m³): Reservoir is in good condition. However, it overflows during low flow conditions in the networks.

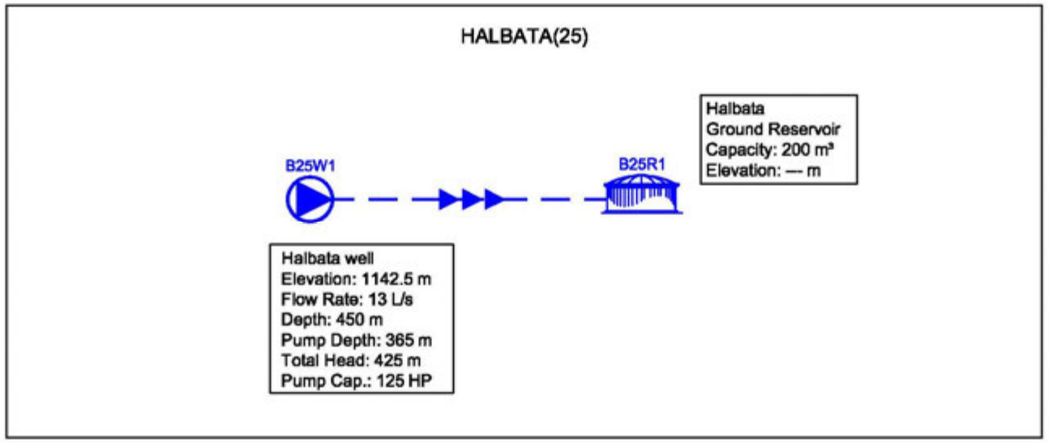
Hadet (El) (24)



The existing water network is in medium condition and it has a length of around 20 km. It covers a part of the town.

Reservoir B24R1 (>10 years; 500 m³): Reservoir is in good condition.

Halbata (25)

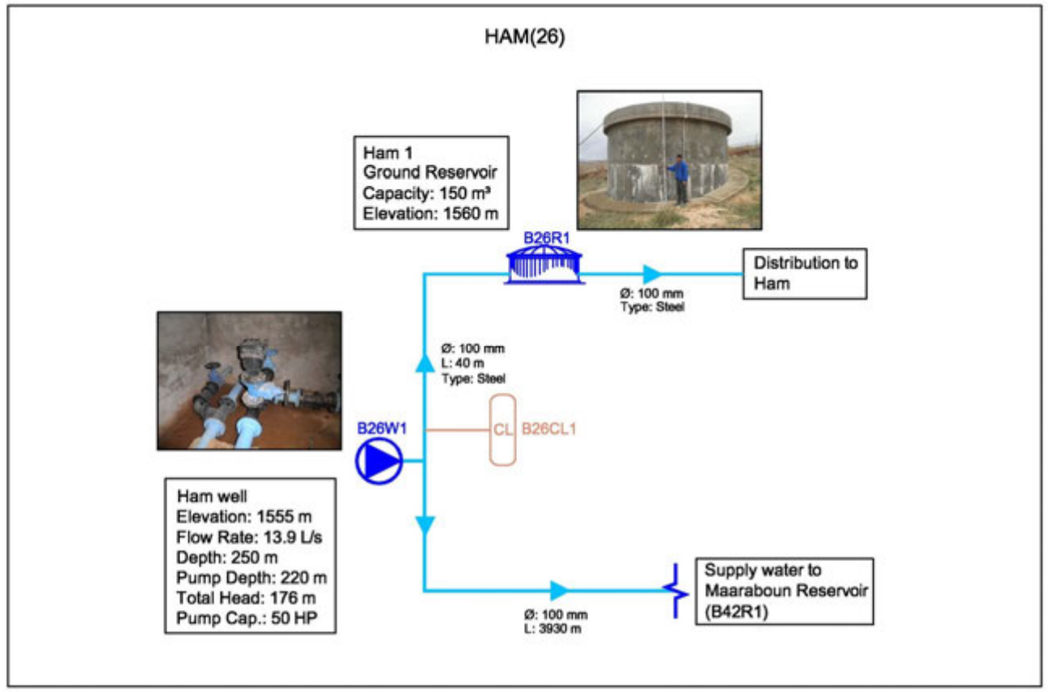


There is no available information concerning the water network of the town.

Well B25W1 (20 years old): Well suffers from a shortage of electric power. No more available information.

Reservoir B25R1 (< 2 years; 200 m³): This reservoir is new and it is in very good condition.

Ham (26)

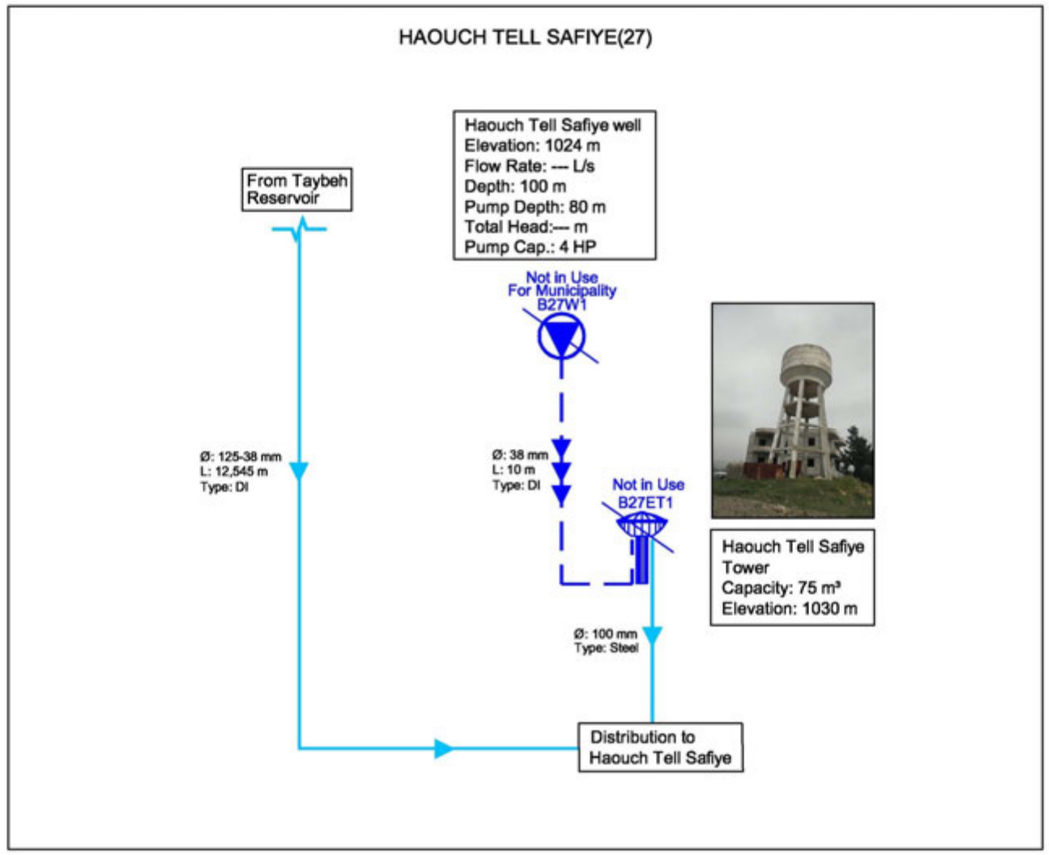


The existing water network is in very good condition and it has a length of around 7.3 km. It covers a large area of the town.

Well B26W1 (>15 years): Well is in good condition but it suffers from a shortage of electric power.

Reservoir B26R1 (150m³): Reservoir is in good condition. It needs esthetical rehabilitation.

Haouch tell safiye (27)

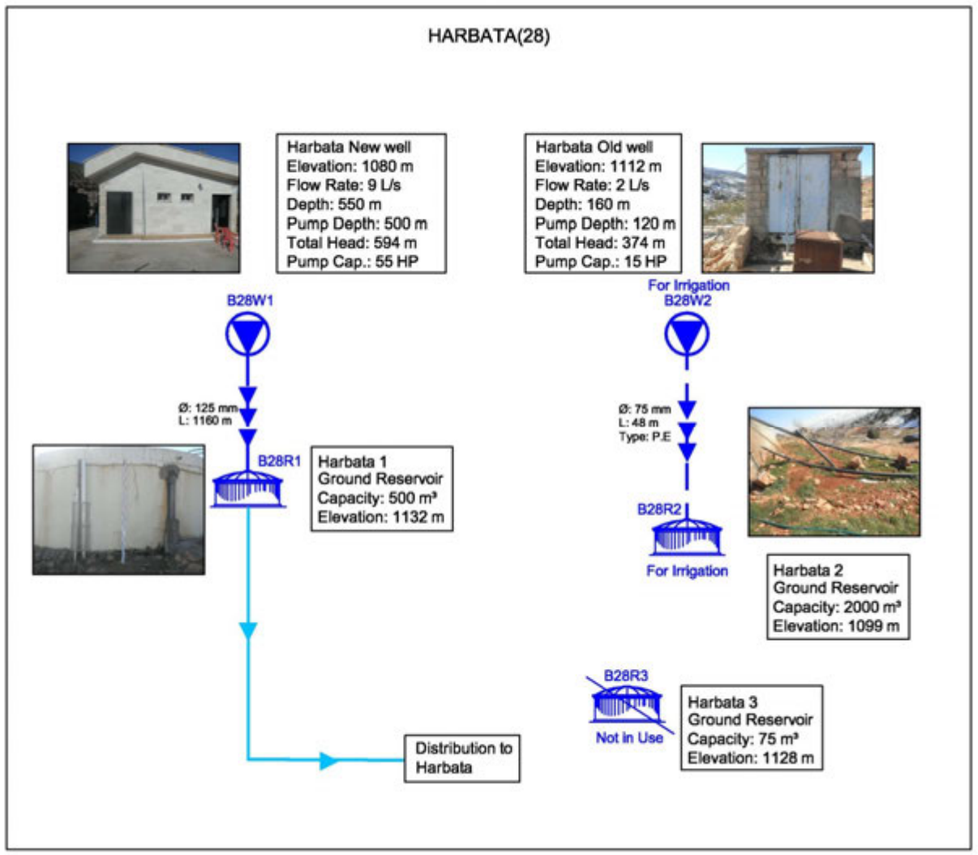


The existing water network is in very good condition and it has a length of around 11.3 km. It covers a large area of the town.

Well B27W1 (10 years old): Well is not in use and it suffers from a shortage of electric power.

Elevated tank B27ET1 (75 m³): Elevated tank is in an acceptable condition but it is not in use. A new network exists and is supplied from Taybe reservoir.

Harbata (28)



The existing water network is in very good condition and it has a length of around 15.7 km. It covers a large area of the town.

Well B28W1 (>10 years): Well is in good condition but it suffers from a shortage of electric power. There is a chlorination room with 2 cylinders but it is not working.

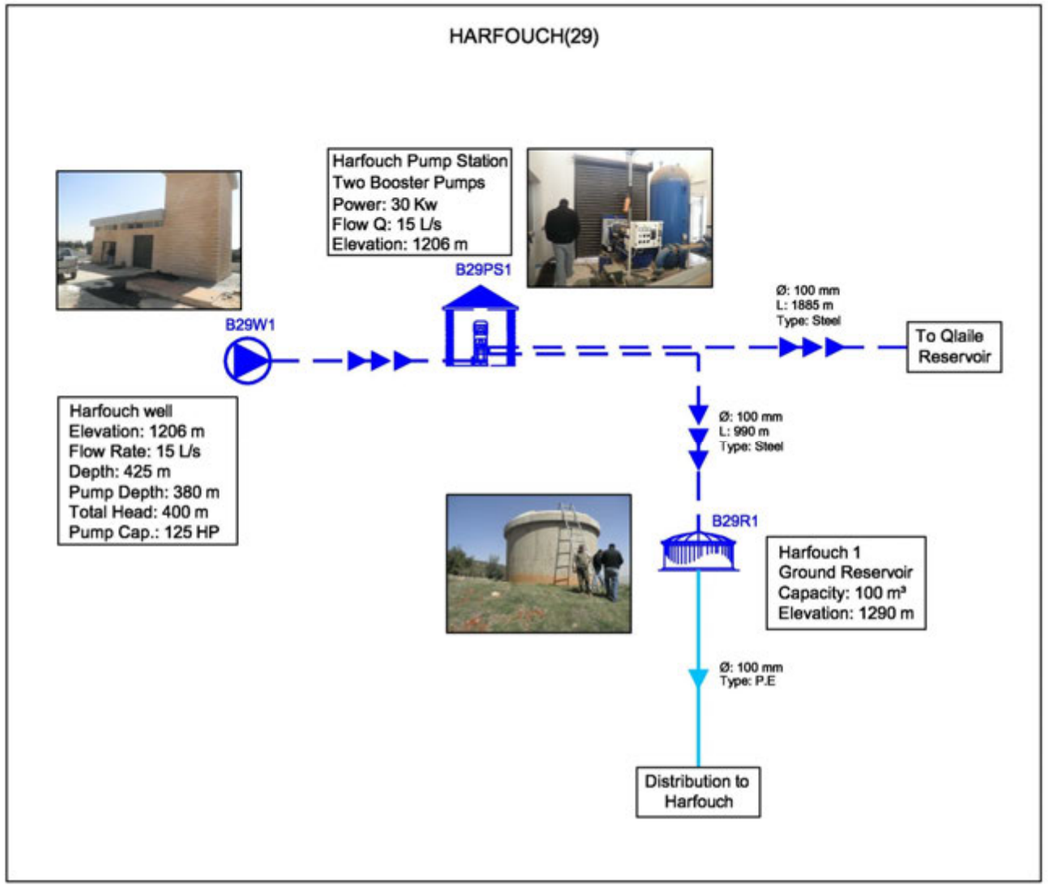
Well B28W2 (15 years old): Well is old and is equipped with a chlorination chamber which is not operational. This well is used for irrigation.

Reservoir B28R1 (>40 years; 500 m³): Reservoir is in bad condition. It needs esthetical and structural rehabilitation. The pipes and valves are rusted and they need maintenance.

Reservoir B28R2 (2000 m³): Reservoir is open-top and it is in an acceptable condition but the inlet and outlet pipes and valves are rusted. This reservoir needs some minor maintenance. This reservoir is used only for irrigation.

Reservoir B28R3 (old; 75 m³): Reservoir is old and it is not in use.

Harfouch (29)



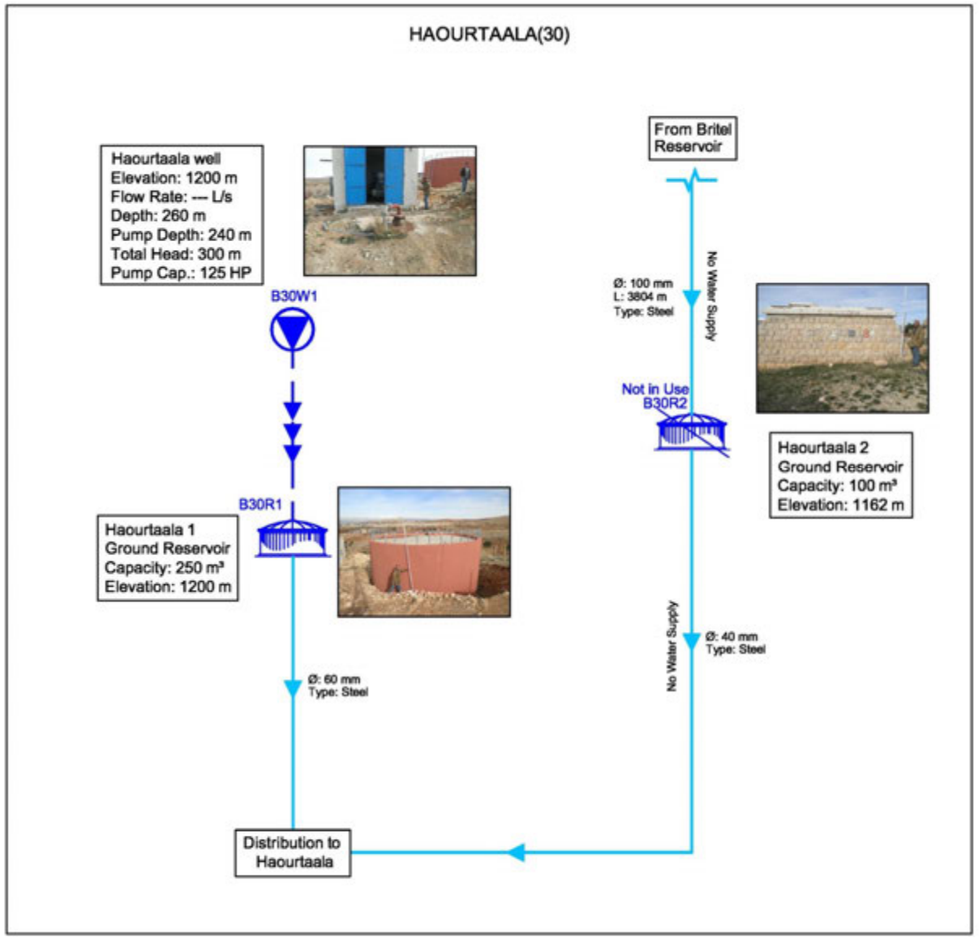
There is no available information concerning the water network of the town.

Well B29W1 (20 years old): Well is in good condition.

Pump station B29PS1: Pump station is in good condition but it is not in use yet.

Reservoir B29R1 (>10 years; 100 m³): Reservoir is in good condition but it is not in use yet.

Haourtaala (30)



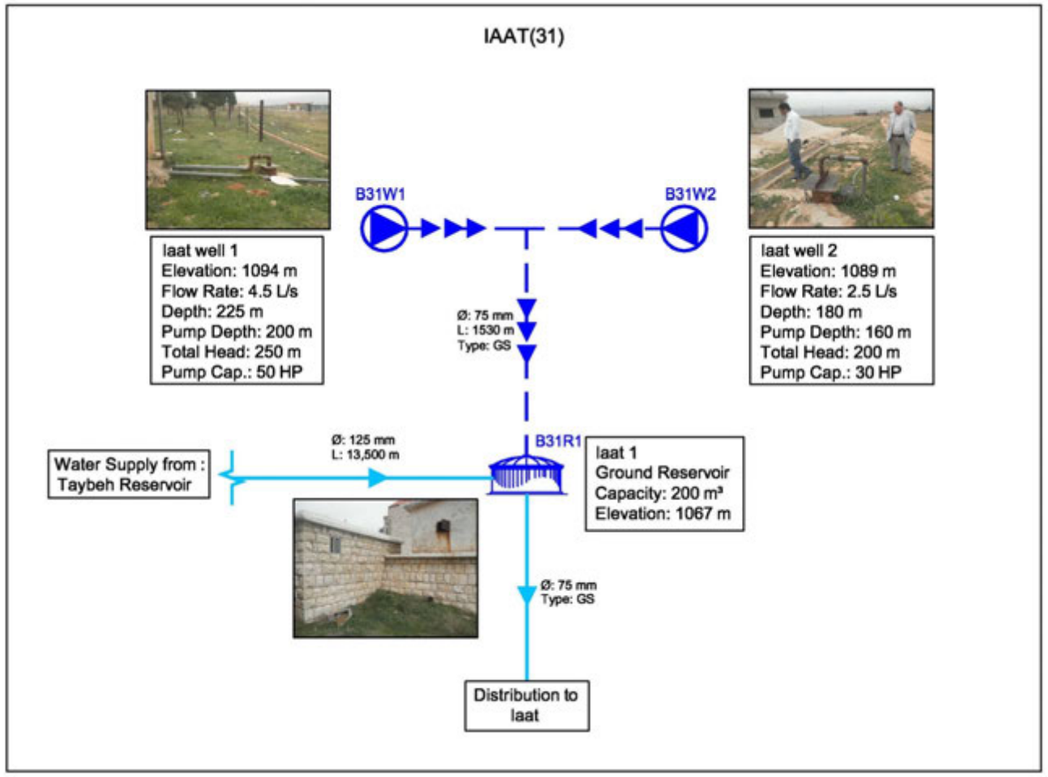
The existing water network is in very good condition and it has a length of around 43 km. It covers a large area of the town.

Well B30W1 (10 years old): Well is in good condition but it suffers from a shortage of electric power.

Reservoir B30R1 (250 m³): Reservoir is in good condition.

Reservoir B30R2 (100 m³): Reservoir is old but it is in an acceptable condition. It needs esthetical rehabilitation. The pipes and valves are rusted and they need maintenance. This reservoir is not in use anymore.

Iaat (31)



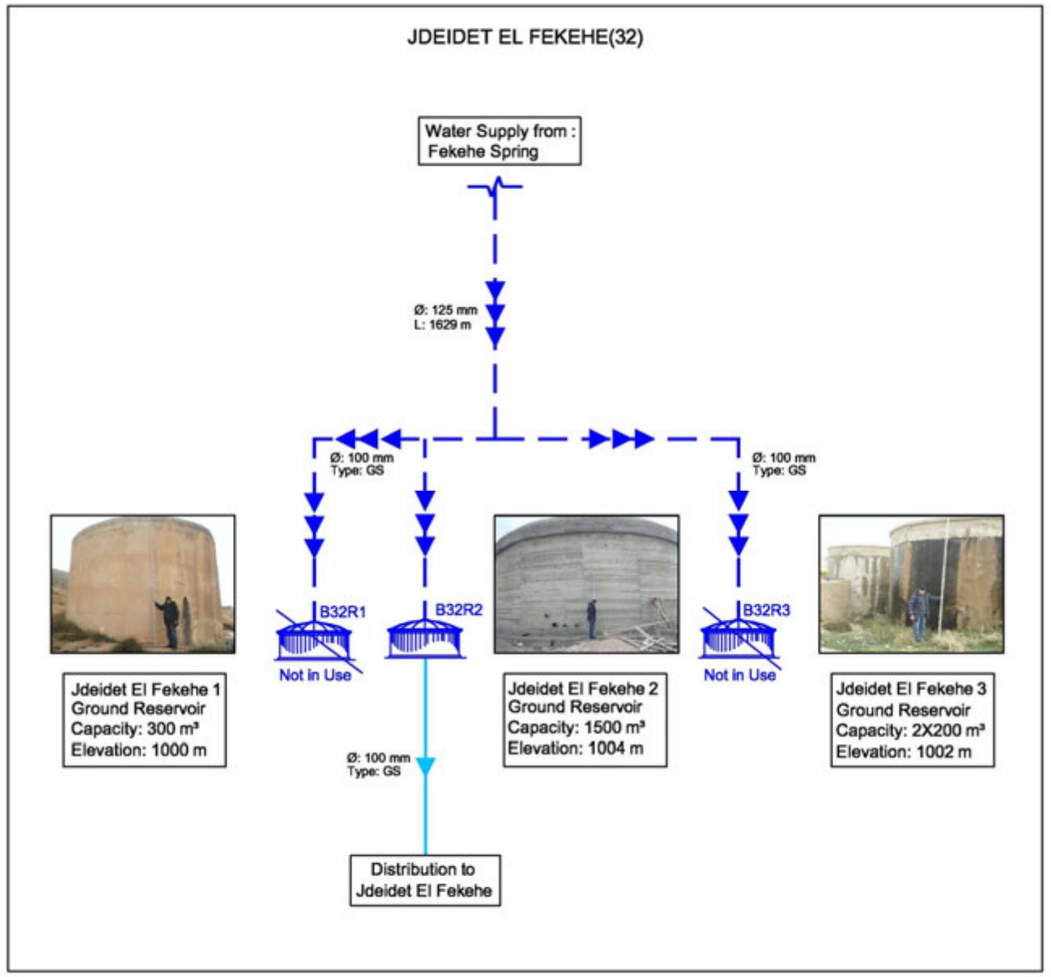
The existing water network is in very good condition and it has a length of around 32.5 km. It covers a large area of the town.

Well B31W1 (15 years old): Well is in good condition.

Well B31W2 (15 years old): Well is in good condition but it suffers from a shortage of electric power.

Reservoir B31R1 (200 m³): Reservoir is old but it is in acceptable condition.

Jdeidet El Fekehe (32)



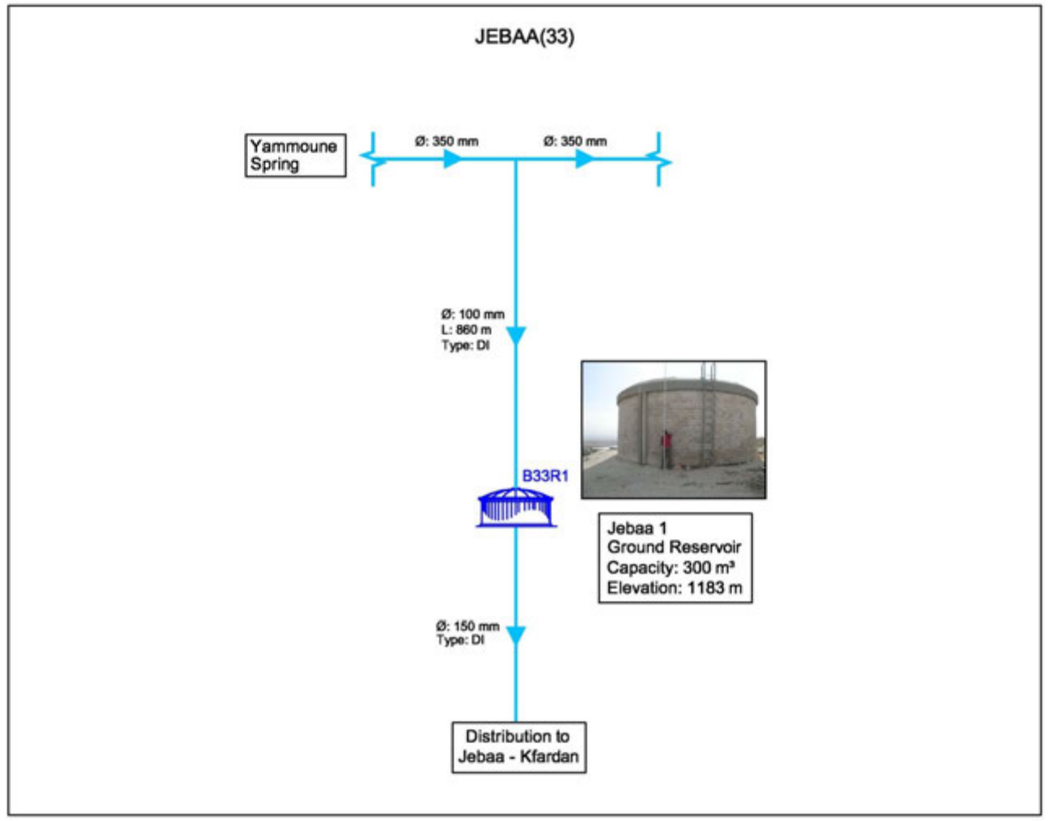
There is no available information concerning the water network of the town.

Reservoir B32R1 (>10 years; 300m³): Reservoir is in bad condition and it is not in use.

Reservoir B32R2 (1500 m³): Reservoir is currently under construction.

Reservoir B32R3 (>35 years; 2x200 m³): Reservoir is in bad condition. It needs esthetical and structural rehabilitation. The pipes and valves are rusted and they need maintenance. This reservoir is not in use.

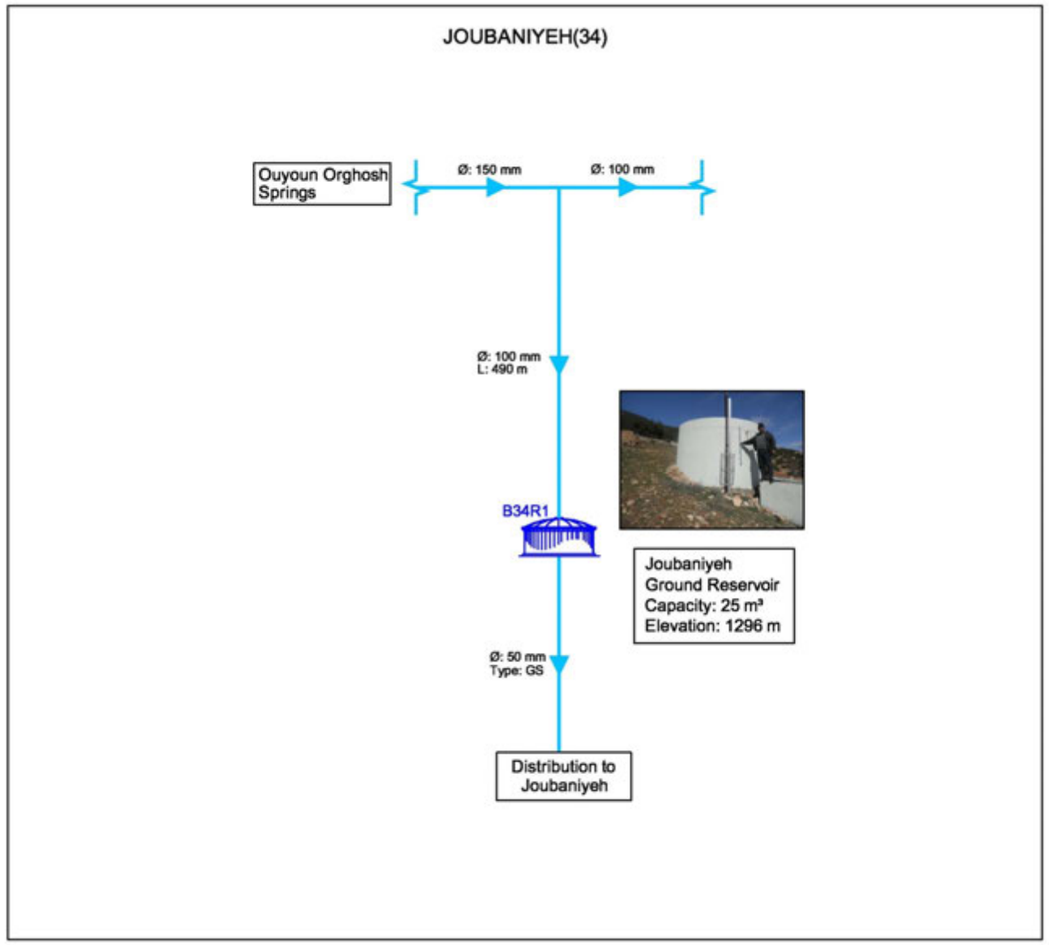
Jebaa (33)



The existing water network is in medium condition and it has a length of around 5.7 km. It covers a large area of the town.

Reservoir B33R1 (>10 years; 300 m³): Reservoir is in good condition.

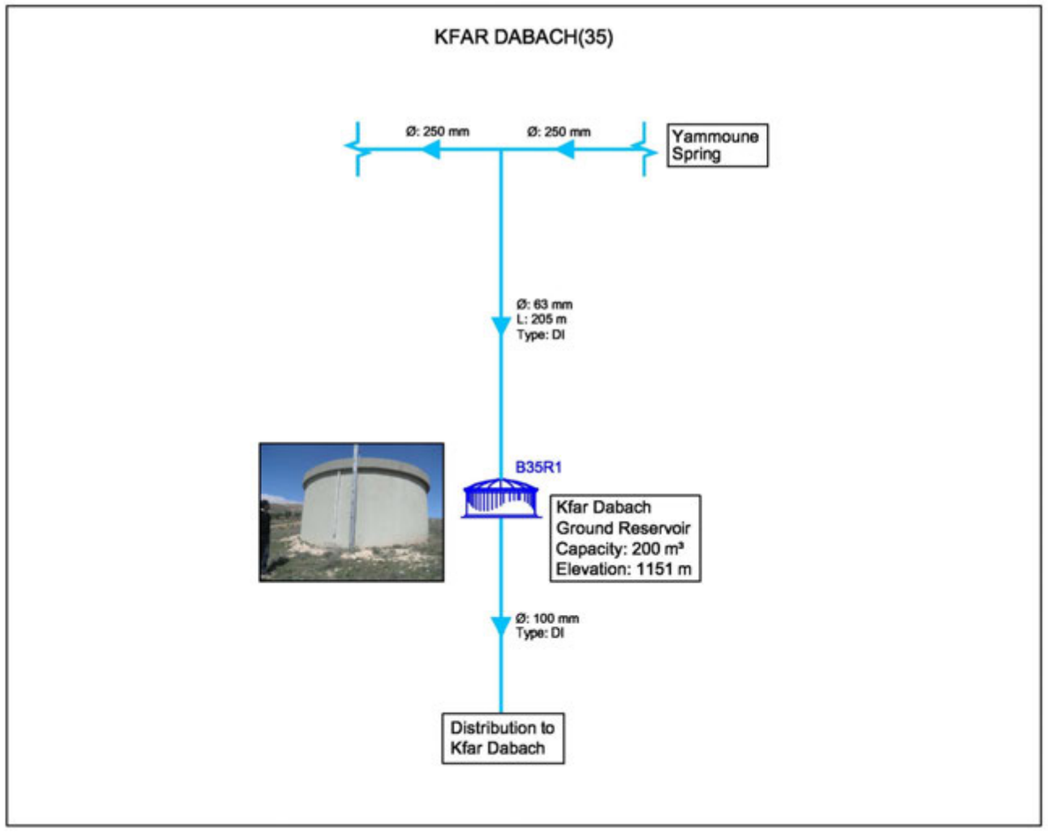
Joubaniyeh (34)



There is no available information concerning the water network of the town.

Reservoir B34R1 (>10 years; 25m³): Reservoir is in good condition.

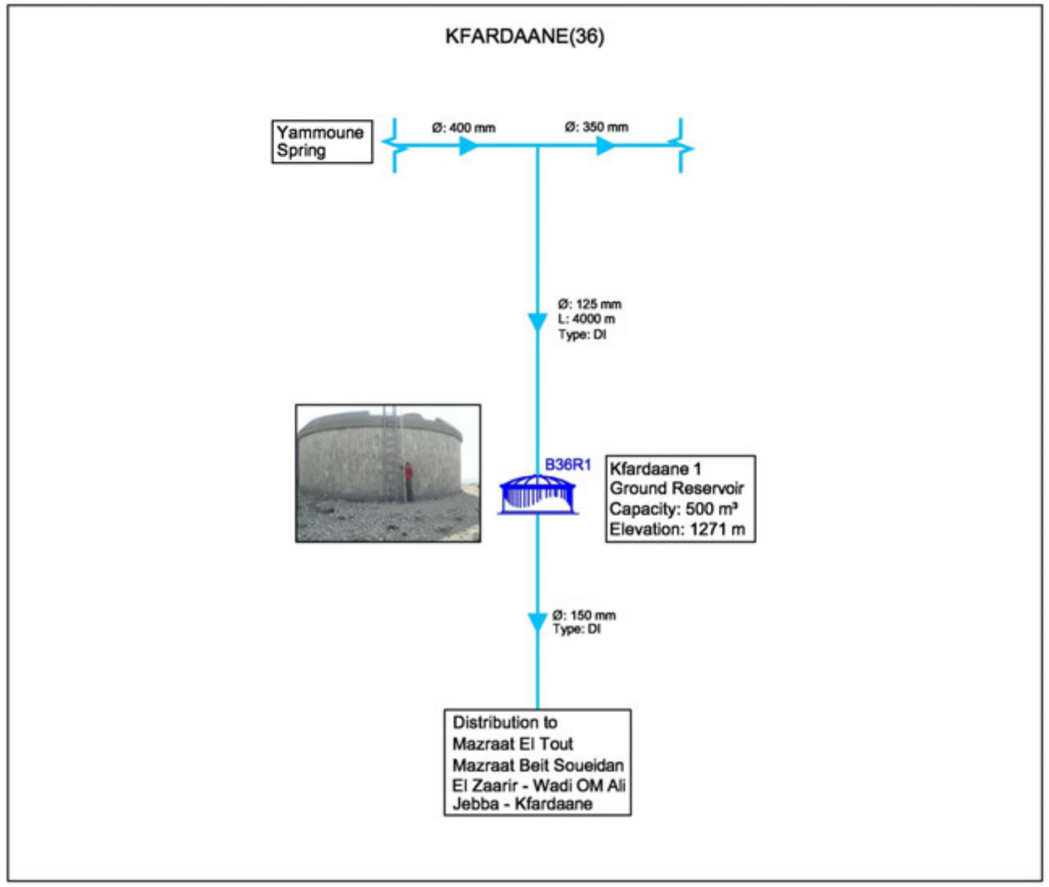
Kfar Dabach (35)



The existing water network is in very good condition and it has a length of around 7.2 km. It covers a large area of the town.

Reservoir B35R1 (10 years old; 200 m³): Reservoir is new and it is in good condition.

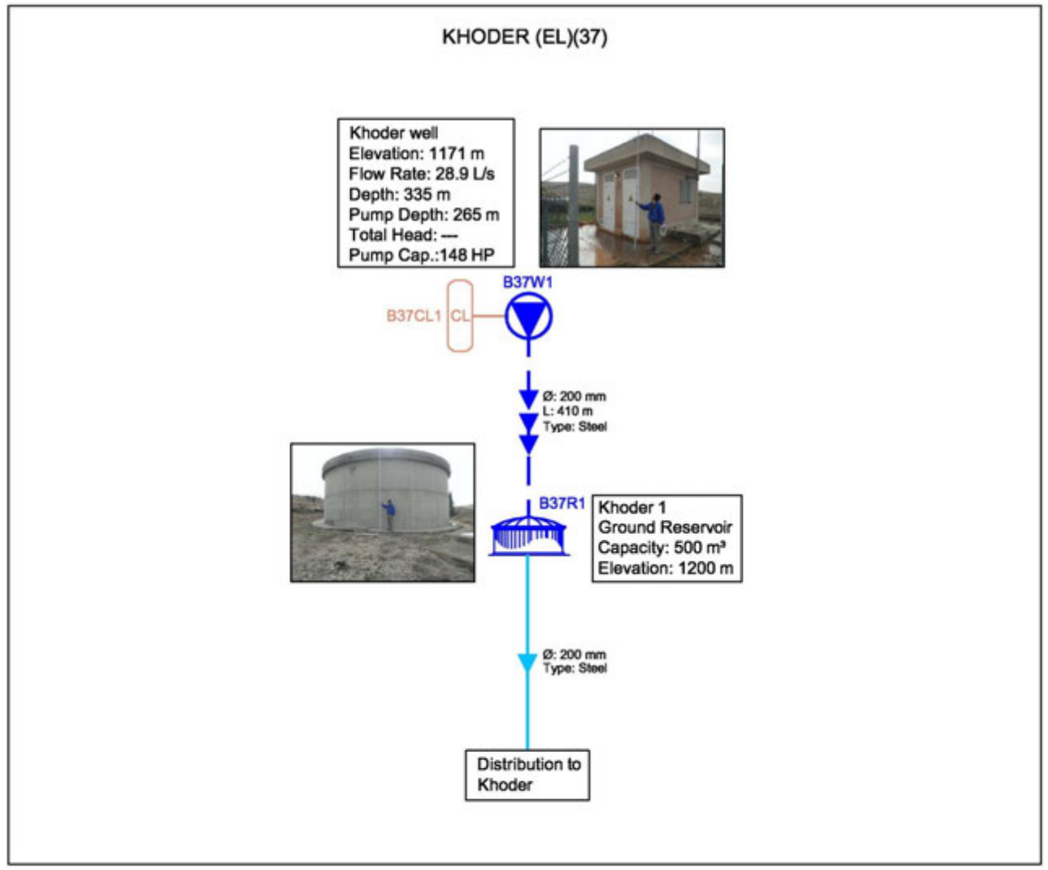
Kfardaane (36)



The existing water network is in very good condition and it has a length of around 16.7 km. It covers a part of the town.

Reservoir B36R1 (>10 years; 500 m³): Reservoir is in good condition.

Khoder (El) (37)

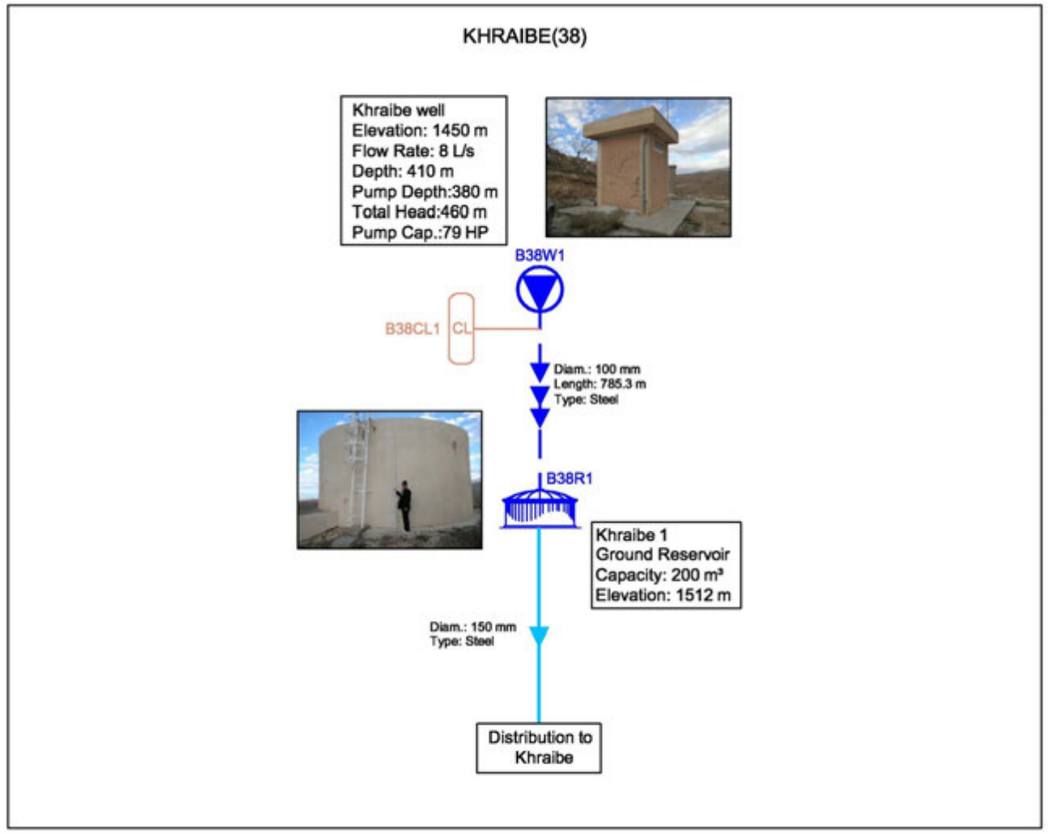


The existing water network is in good condition and it has a length of around 10.5 km. It covers a large area of the town.

Well B37W1 (>15 years): Well is in good condition but it suffers from a shortage of electric power.

Reservoir B37R1 (500 m³): Reservoir is in good condition.

Khraibe (38)

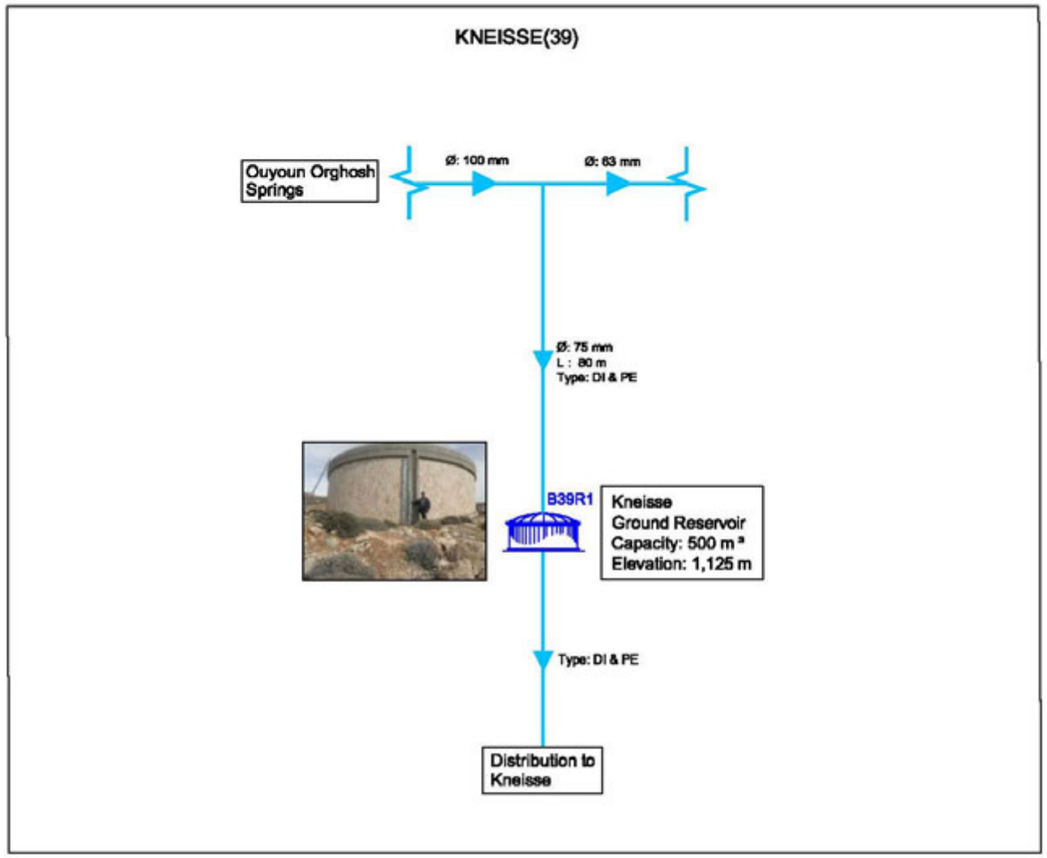


The existing water network is in bad condition and it has a length of around 7.4 km. It covers a large area of the town.

Well B38W1 (>15 years): Well is in good condition but it suffers from a shortage of electric power. It has a chlorination unit.

Reservoir B38R1 (200 m³): Reservoir is in good condition.

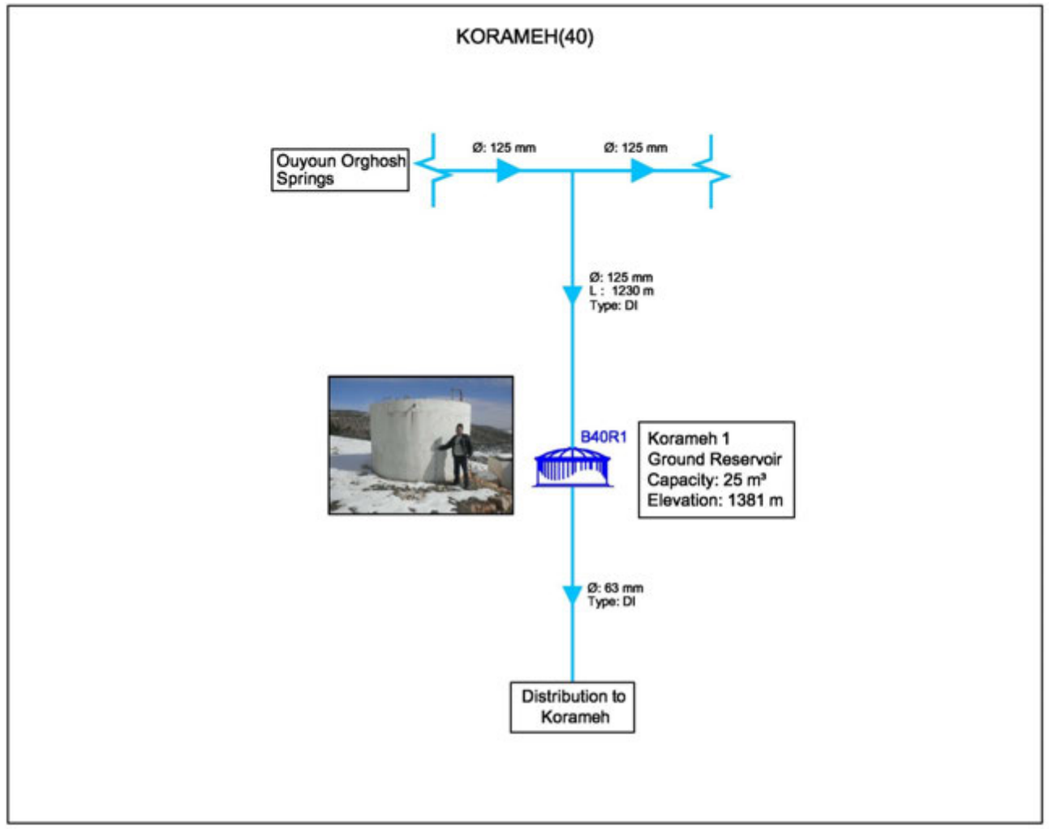
Kneisse (39)



The existing water network is in very good condition and it has a length of around 6.8 km. It covers a large area of the town.

Reservoir B39R1 (>10 years; 500 m³): Reservoir is in good condition.

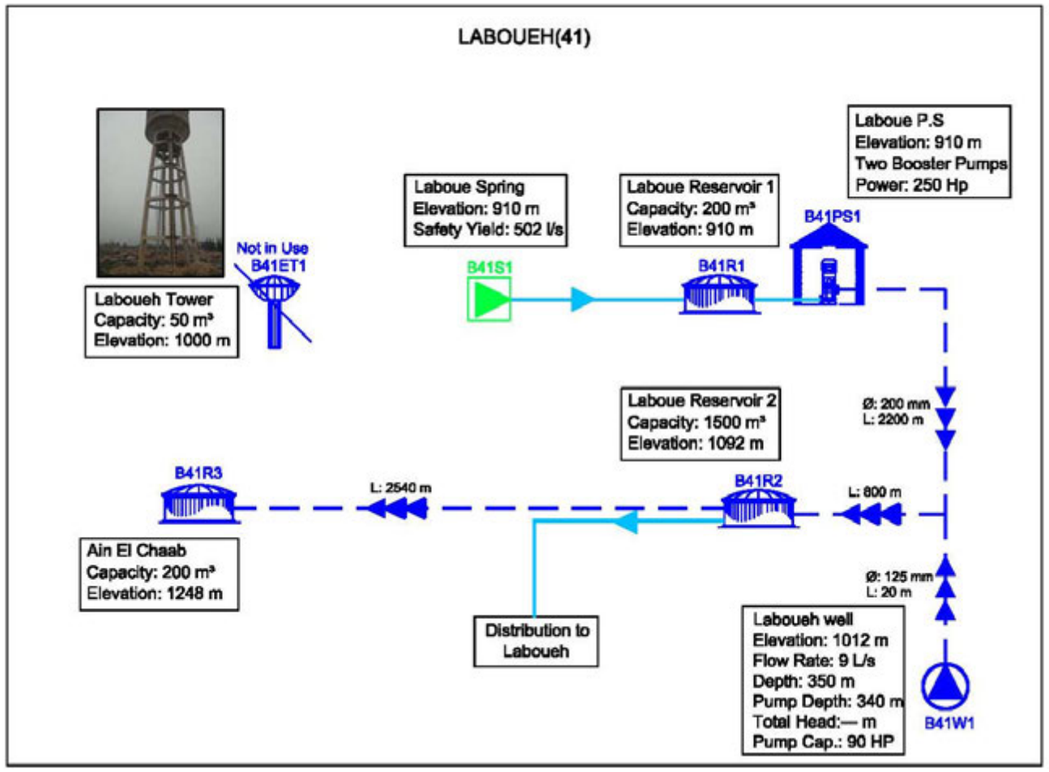
Korameh (40)



There is no available information concerning the water network of the town.

Reservoir B40R1 (25 m³): Reservoir is in an acceptable condition. Its pipes are rusted and subjected to leakage. It needs some minor maintenance.

Laboueh (41)



The existing water network is in very good condition and it has a length of around 59 km. It covers a large area of the town.

Well B41W1 (<5 years): Well is new and it is in good condition.

Elevated tank B41ET1 (45 years old; 50 m³): Elevated tank is old but it is in an acceptable condition but it is not in use. This reservoir needs rehabilitation.

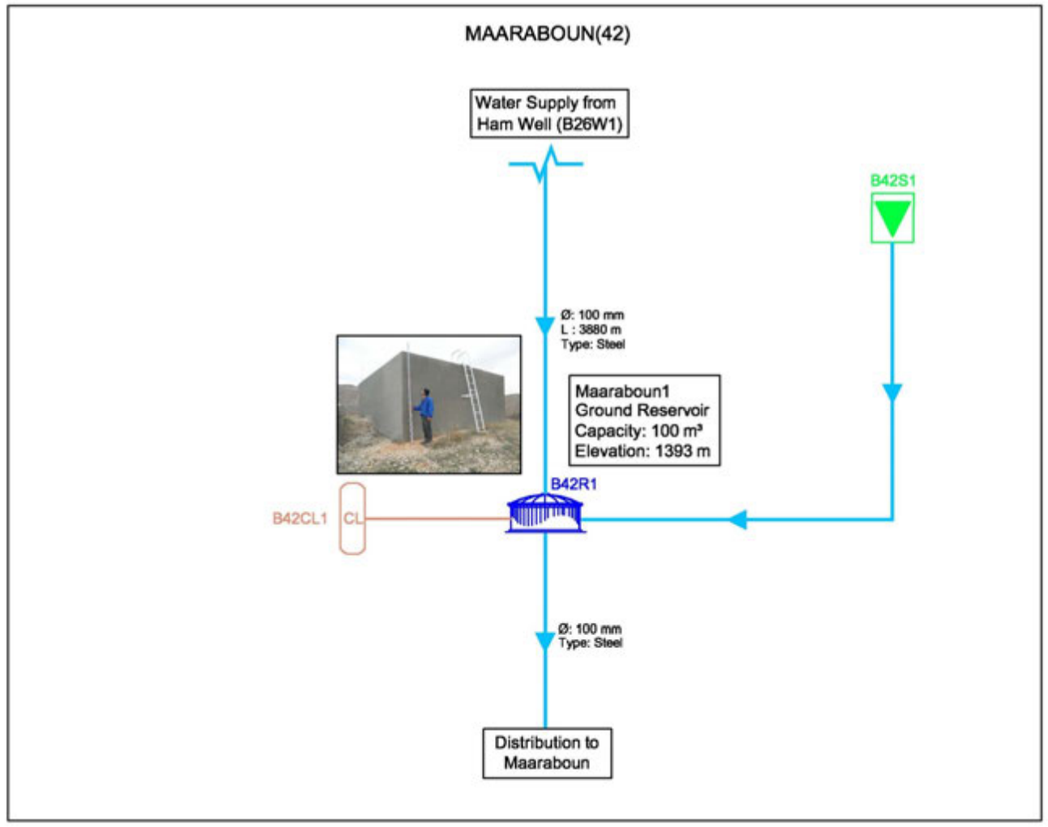
Spring B41S1: The safe yield of this spring is 502 l/s.

Reservoir B41R1 (200 m³): This reservoir is for the pump station.

Reservoir B41R2 (< 2 years, 1500 m³), B41R3 (<2 years, 200 m³): Reservoirs are new and they are in a very good condition.

Pump station B41PS1: No available information.

Maaraboun (42)

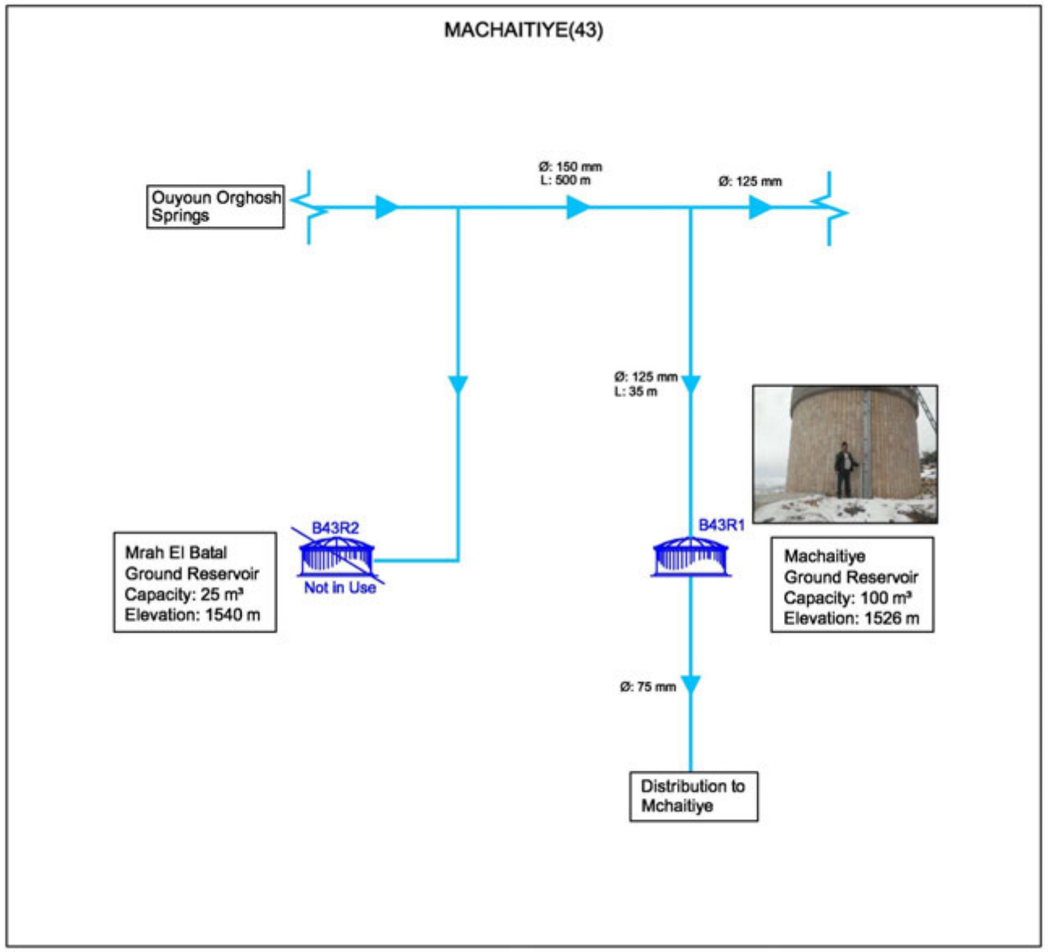


The existing water network is in bad condition and it has a length of around 4.6 km. It covers a large area of the town.

Reservoir B42R1 (100 m³): Reservoir is in good condition.

Spring B42S1: No available information

Machaitiye (43)

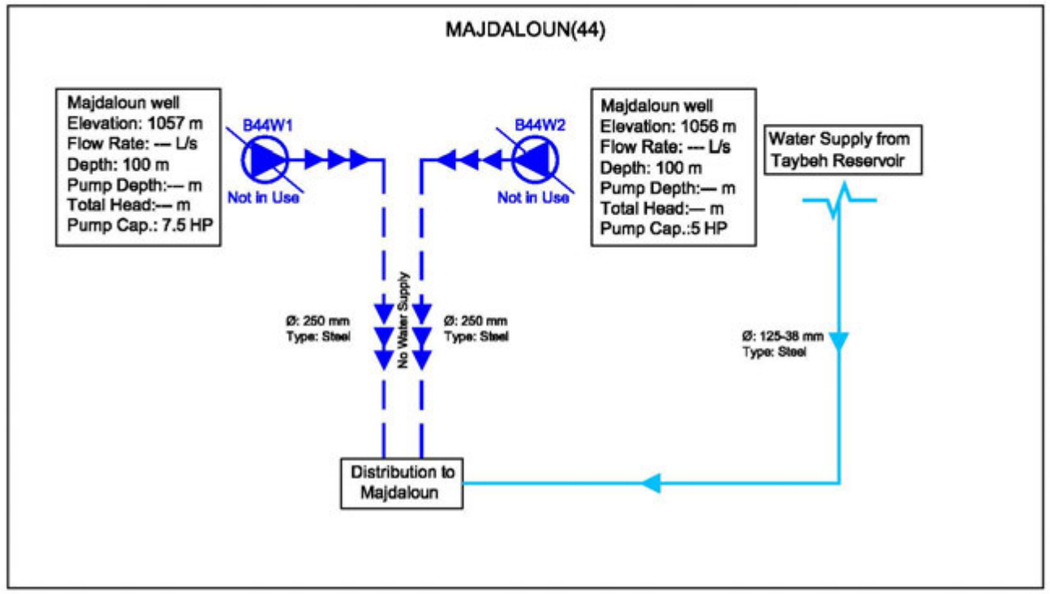


The existing water network is in good condition and it has a length of around 6.2 km. It covers a large area of the town.

Reservoir B43R1 (100 m³): Reservoir is in good condition.

Reservoir B43R2 (25 m³): Reservoir is not in use.

Majdaloun (44)

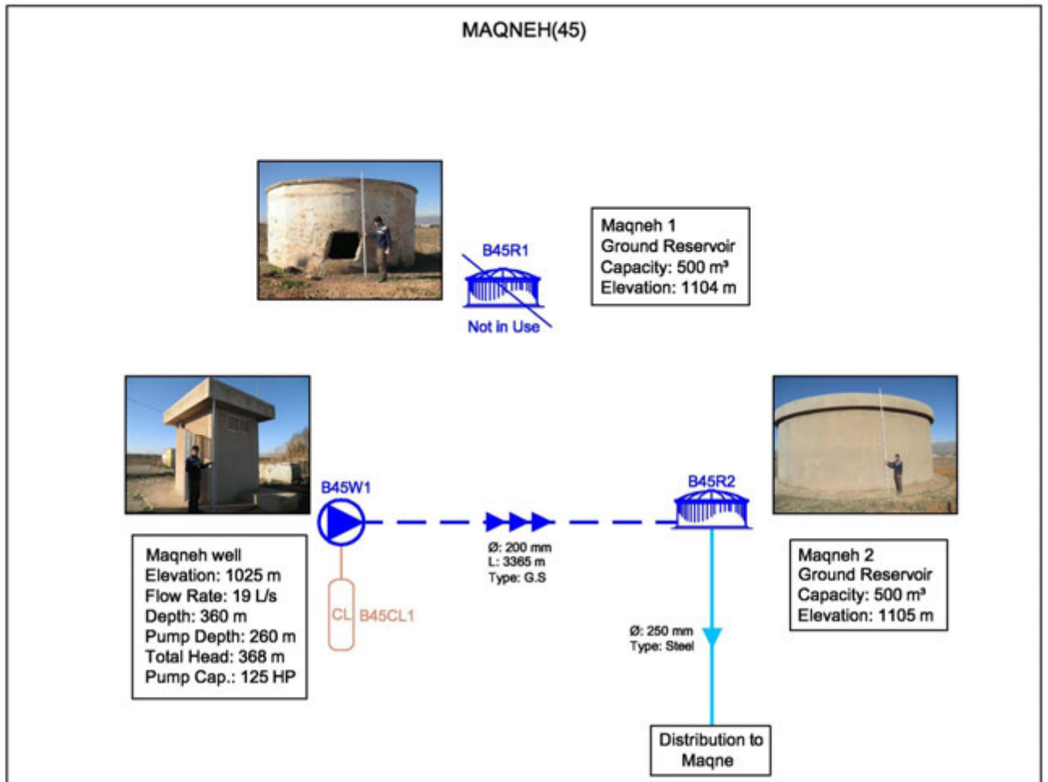


The existing water network is in good condition and it has a length of around 4.3 km. It covers a large area of the town.

Well B44W1 (15 years old): Well is not in use.

Well B44W2 (15 years old): Well is not in use.

Maqneh (45)



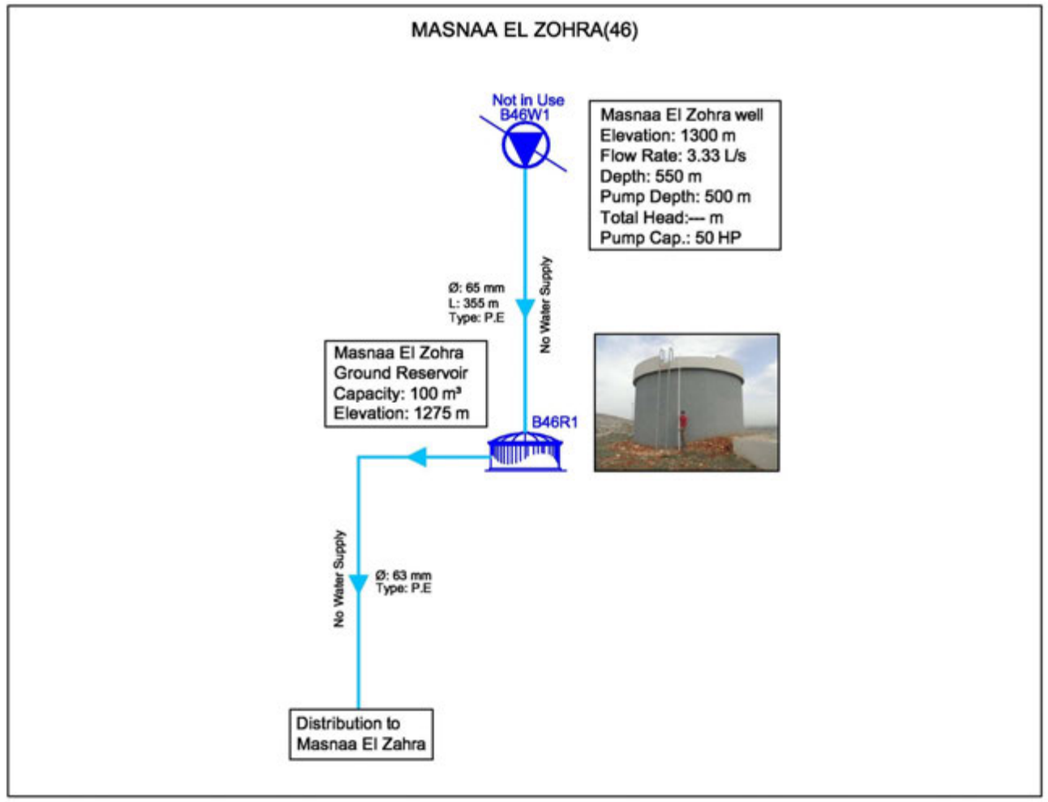
The existing water network is 13 years old and it is in good condition.

Well B45W1 (>10 years): Well is in good condition.

Reservoir B45R1 (500 m³): Reservoir is in bad condition and it is not in use. This reservoir is structurally damaged. It needs rehabilitation or reconstruction. The pipes and valves are rusted and they need maintenance.

Reservoir B45R2 (>10 years; 500 m³): Reservoir is in good condition.

Masnaa El Zohra (46)

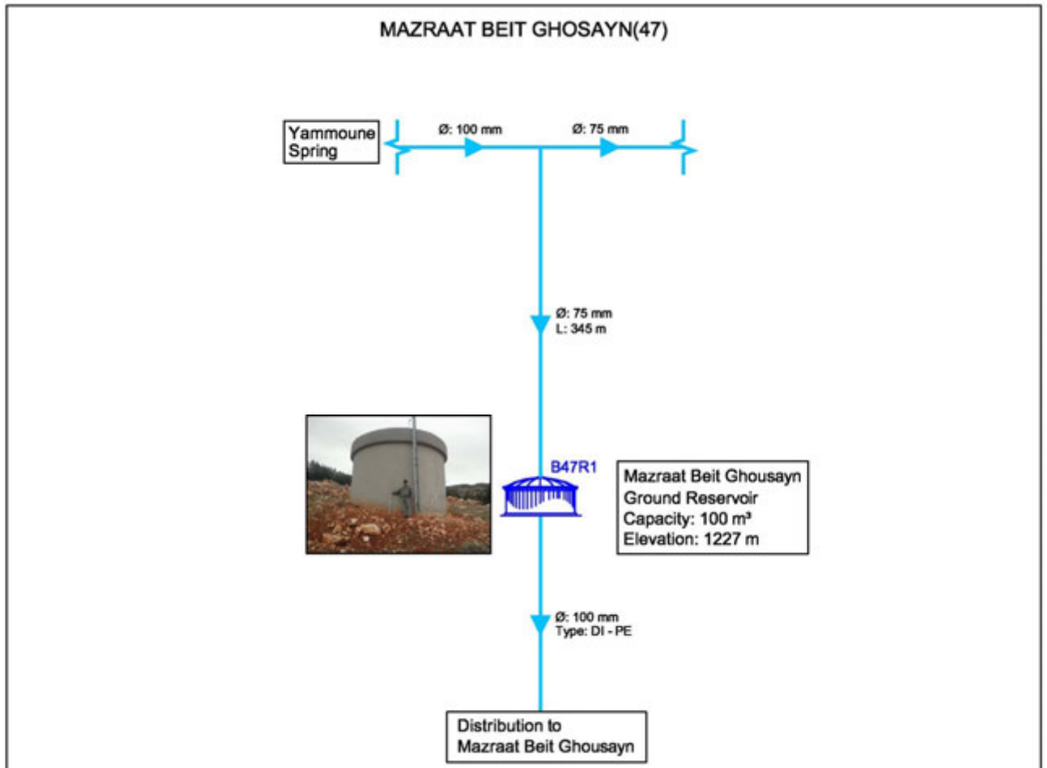


There is no available information concerning the water network of the town.

Well B46W1: Well is not in use.

Reservoir B46R1 (>10 years; 100 m³): Reservoir is in good condition.

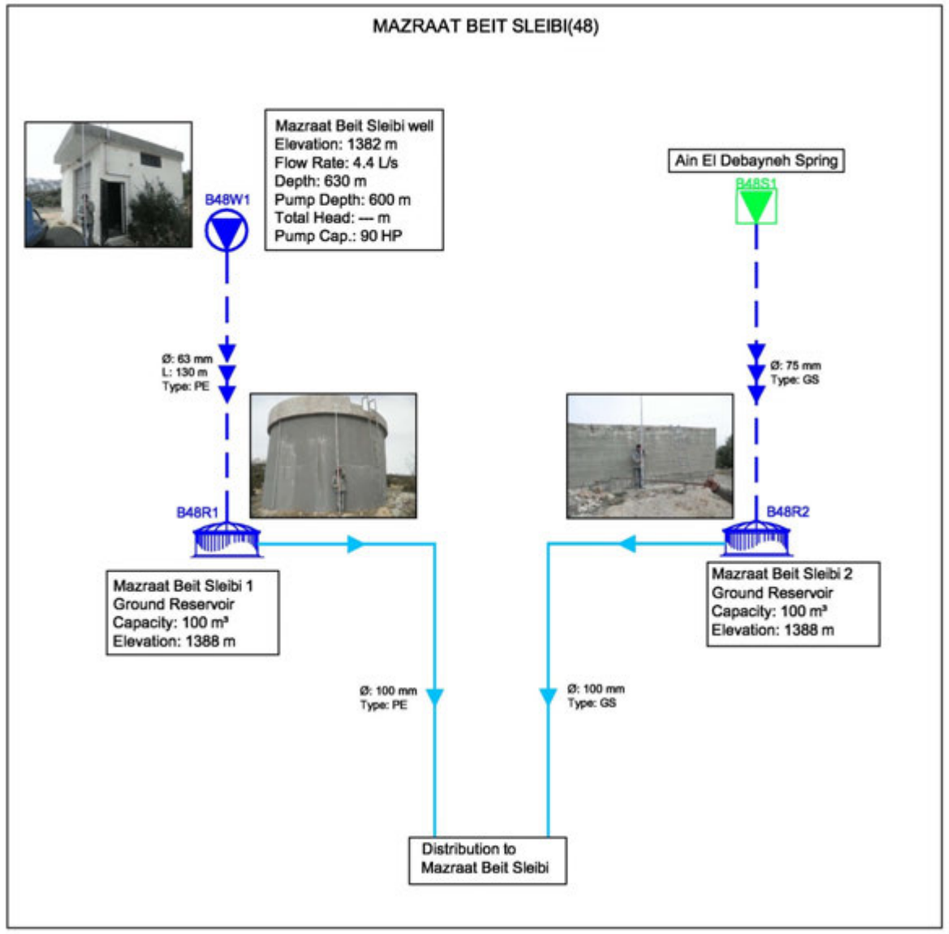
Mazraat Beit Ghosayn (47)



There is no available information concerning the water network of the town.

Reservoir B47R1 (>10 years; 100 m³): Reservoir is in good condition.

Mazraat Beit Sleibi (48)



The existing water network is in very good condition and it has a length of around 9.3 km. It covers a large area of the town.

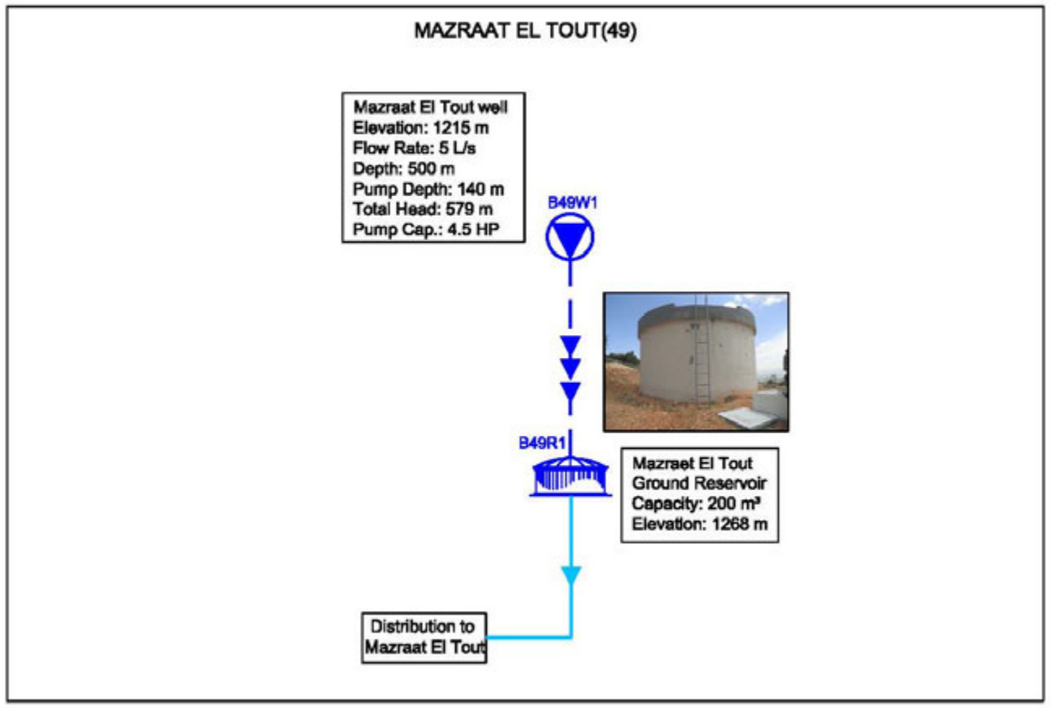
Well B48W1 (20 years old): Well is in good condition and directly supplies the water distribution network. It has a power generator.

Spring B48S1: No available information.

Reservoir B48R1 (<10 years; 100 m³): Reservoir is in good condition but it is not in use.

Reservoir B48R2 (100 m³): Reservoir is in an acceptable condition. It is subject to leakage and the valve chamber is damaged and filled with vegetation and water.

Mazraat El Tout (49)

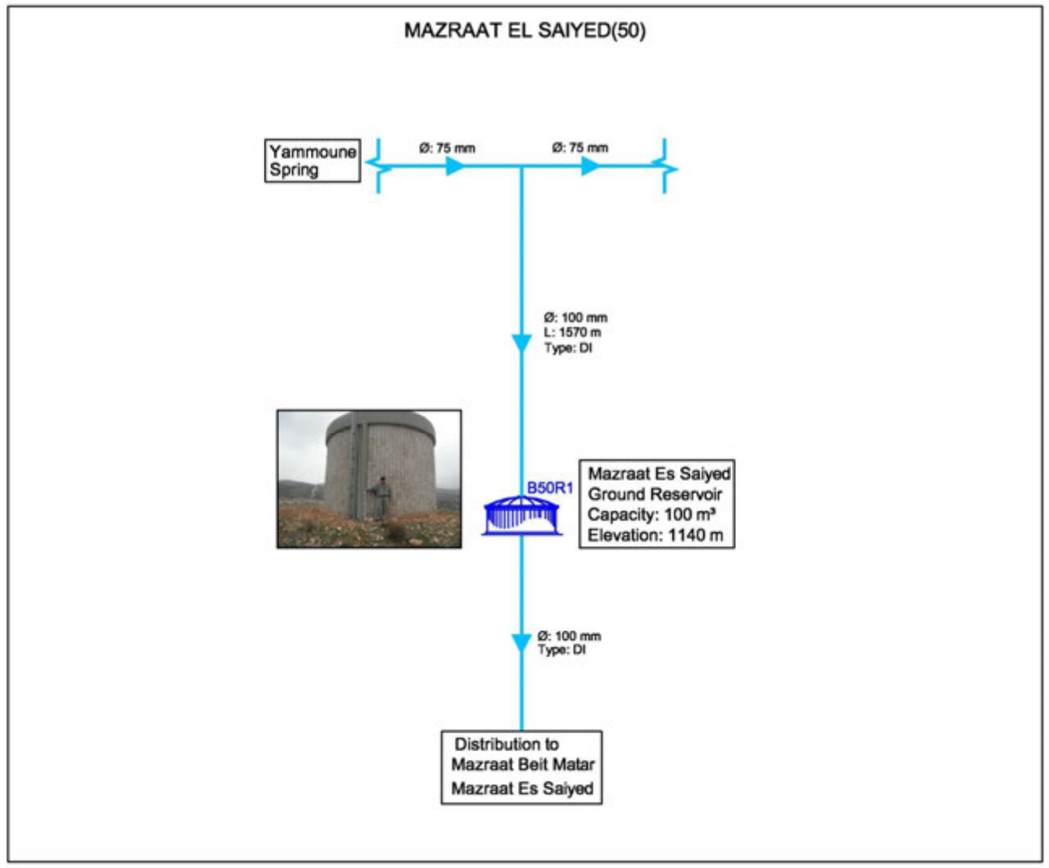


There is no available information concerning the water network of the town.

Well B49W1 (5 years old): It is a newly drilled well. This well suffers from a shortage of electric power.

Reservoir B49R1 (5 years old; 200 m³): Reservoir is in good condition.

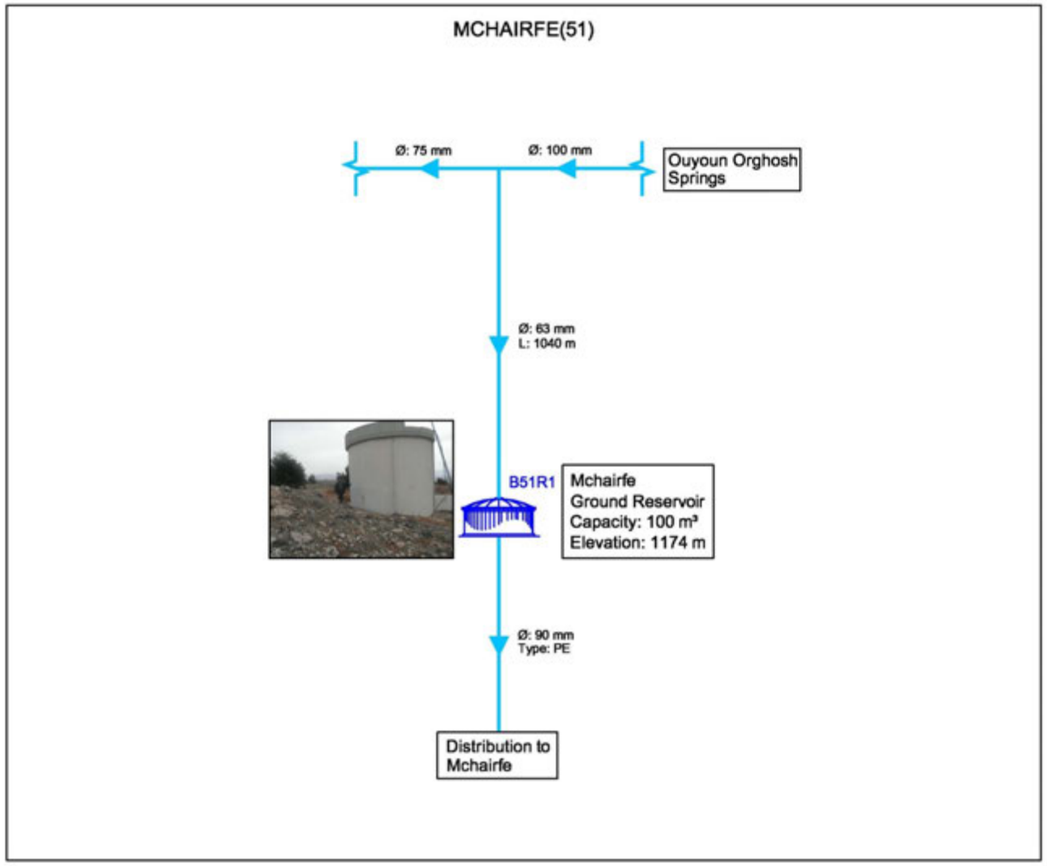
Mazraat El Saiyed (50)



The existing water network is in very good condition and it has a length of around 10 km. It covers a large area of the town.

Reservoir B50R1 (>10 years; 100 m³): Reservoir is in good condition.

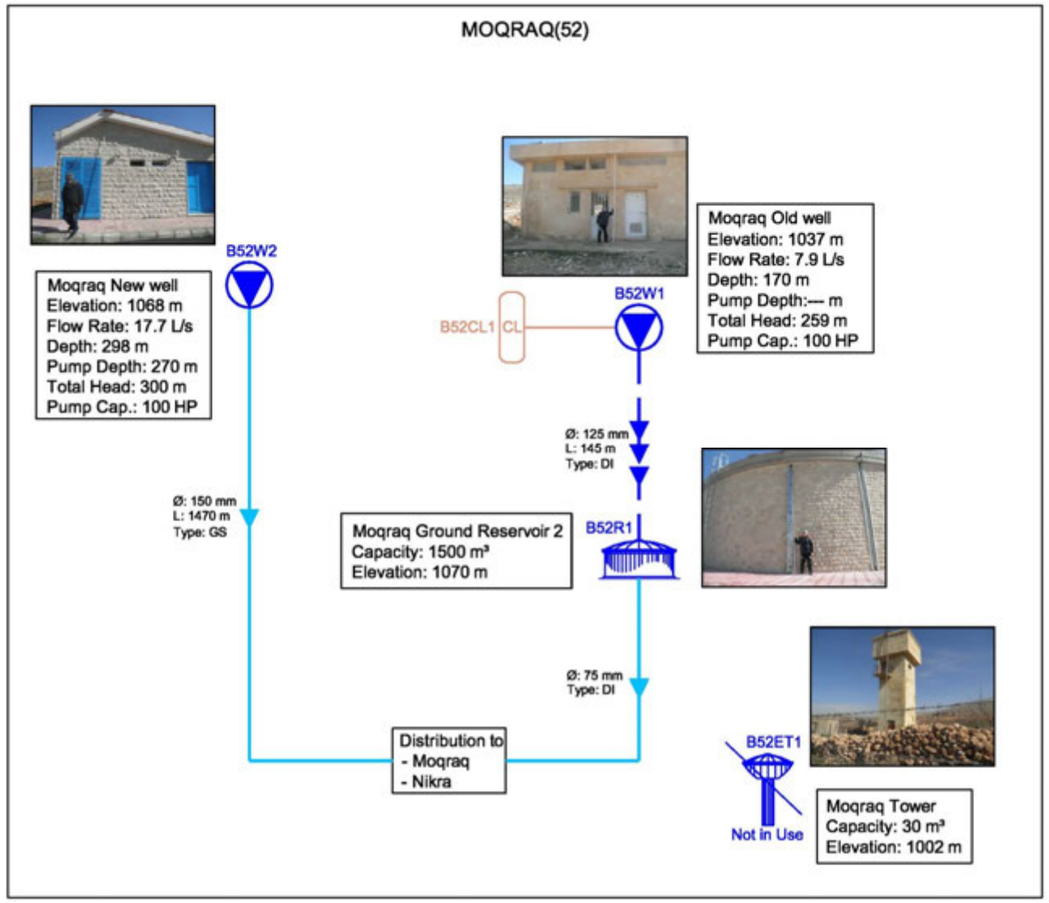
Mchairfe (51)



There is no available information concerning the water network of the town.

Reservoir B51R1 (>10 years; 100 m³): Reservoir is in good condition.

Moqraq (52)



The existing water network is in very good condition and it has a length of around 31.3 km. It covers a large area of the town.

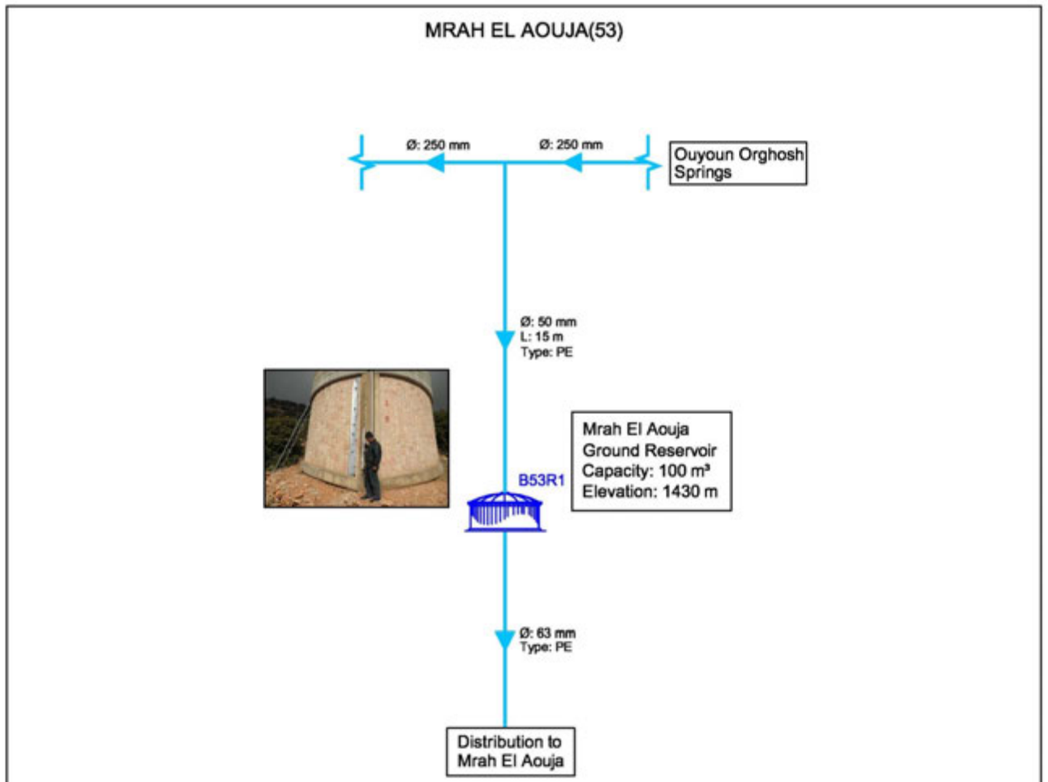
Well B52W1 (35 years old): Well is old and it is in bad condition. Its building needs rehabilitation and its electric power needs to be changed.

Well B52W2 (5 years old): Well is new and it is in good condition but it suffers from a shortage of electric power. It is equipped with a chlorination room but it is not functioning. This well has a power generator.

Reservoir B52R1 (5 years old; 1500 m³): Reservoir is in good condition.

Elevated tank B52ET1 (45 years old; 30 m³): Elevated tank is very old and it is in bad condition. This elevated tank is not in use.

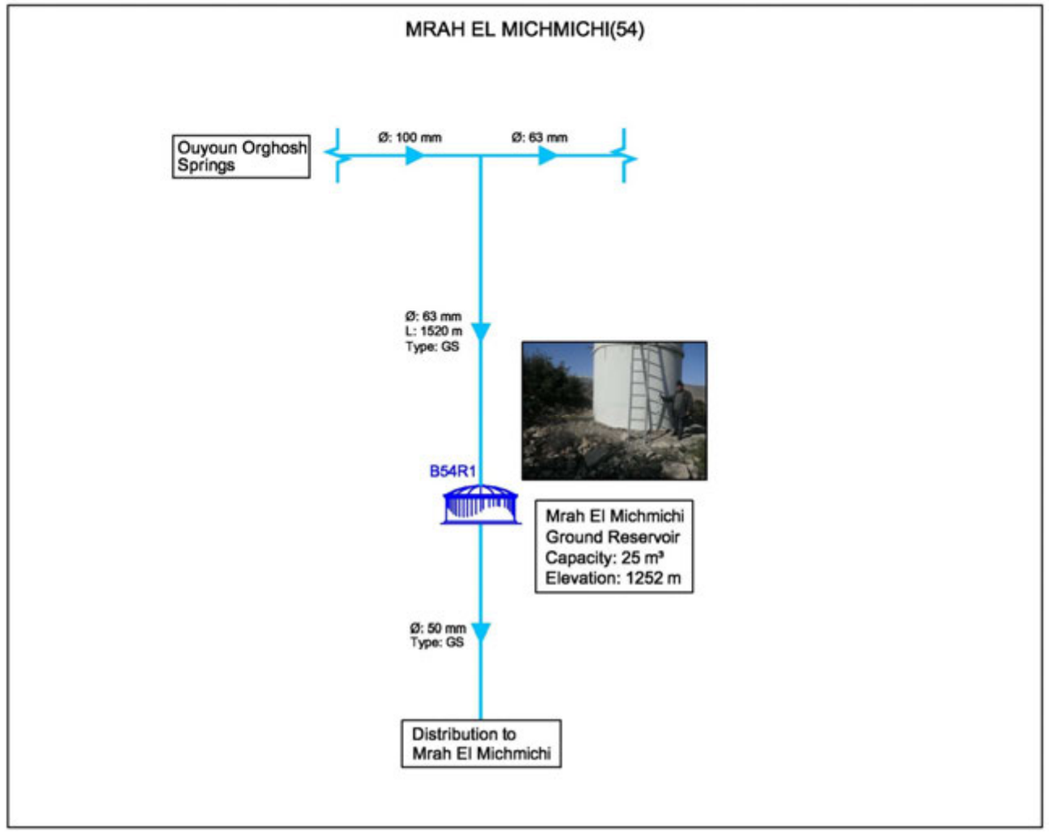
Mrah El Aouja (53)



There is no available information concerning the water network of the town.

Reservoir B53R1 (>10 years; 100 m³): Reservoir is in good condition.

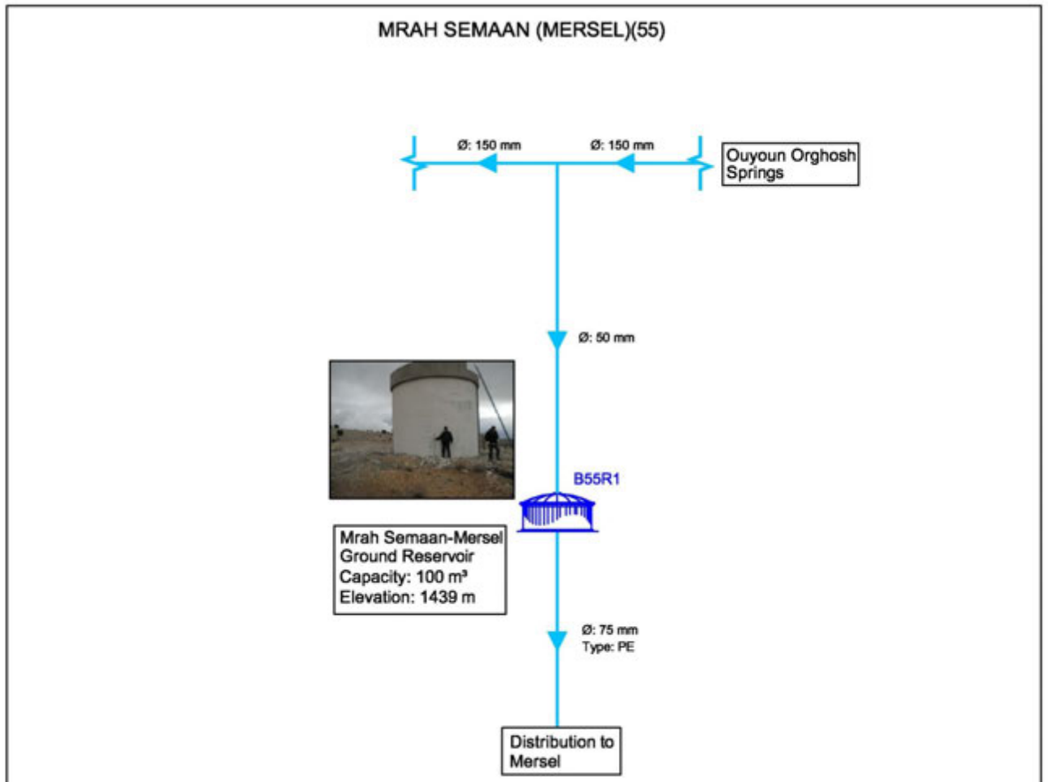
Mrah El Michmichi (54)



There is no available information concerning the water network of the town.

Reservoir B54R1 (25 m³): Reservoir is in good condition.

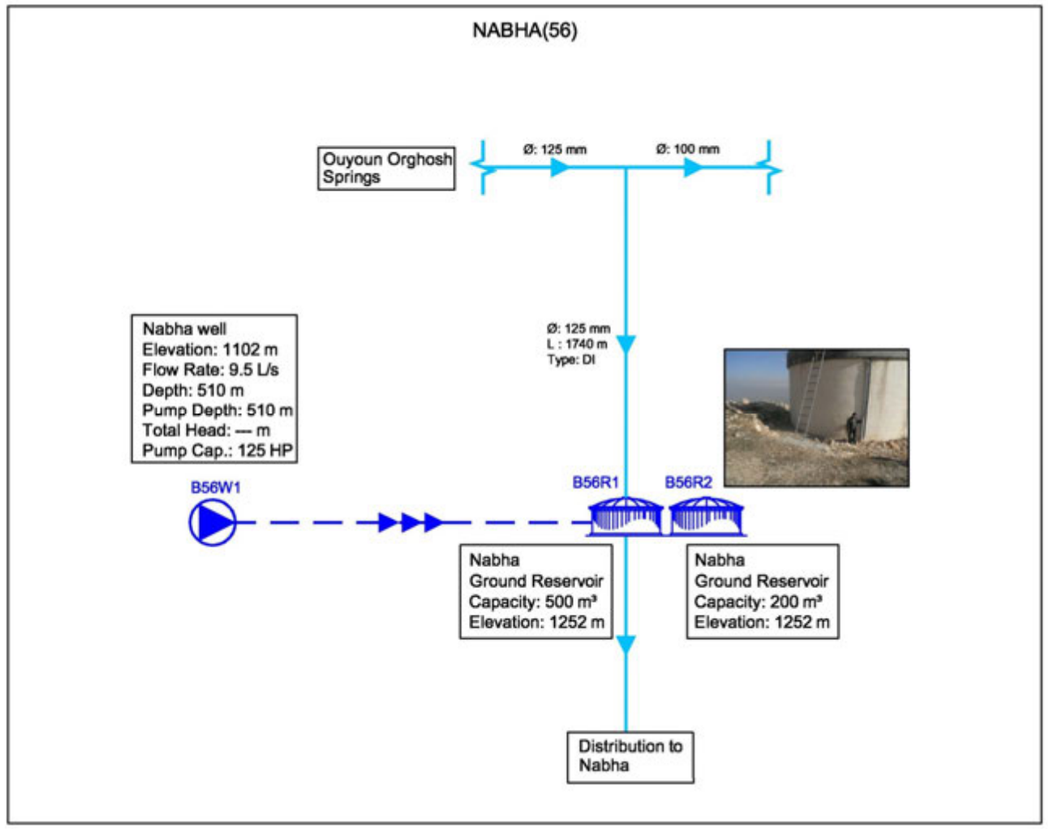
Mrah Semaan (55)



There is no available information concerning the water network of the town.

Reservoir B55R1 (100 m³): Reservoir is new and it is in good condition.

Nabha (56)



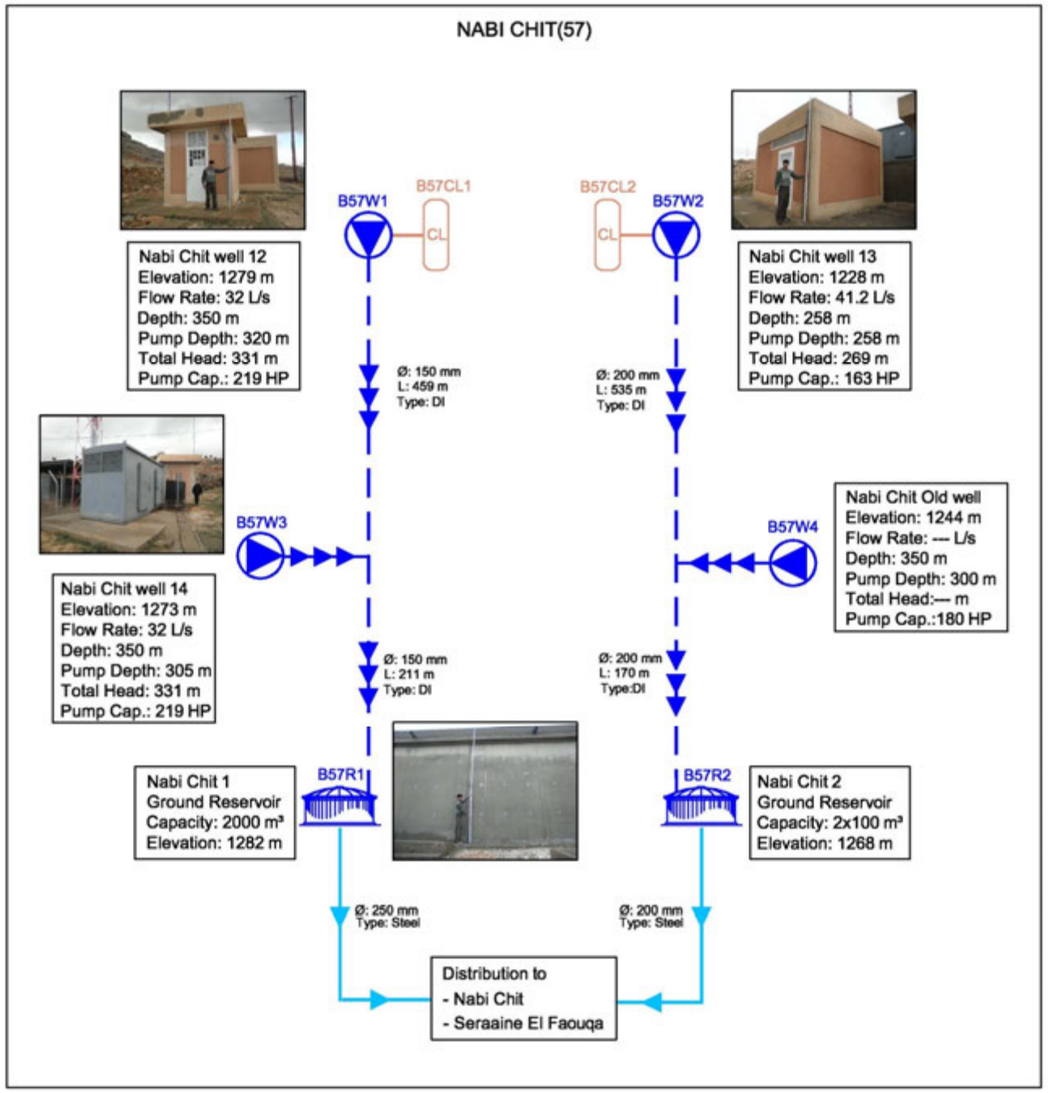
The existing water network is in medium condition and it has a length of around 41 km. It covers a large area of the town.

Well B56W1 (5 years old): Well is in good condition. No more available information.

Reservoir B56R1 (>10 years; 500 m³): Reservoir is in good condition.

Reservoir B56R2 (200 m³): Reservoir is in good condition.

Nabi Chit (57)



The existing water network is in good condition and it has a length of around 34 km. It covers a large area of the town.

Well B57W1 (>15 years): Well is in good condition but it suffers from a shortage of electric power. It has a power generator but it is not always operational.

Well B57W2 (>15 years): Well is in good condition but it suffers from a shortage of electric power.

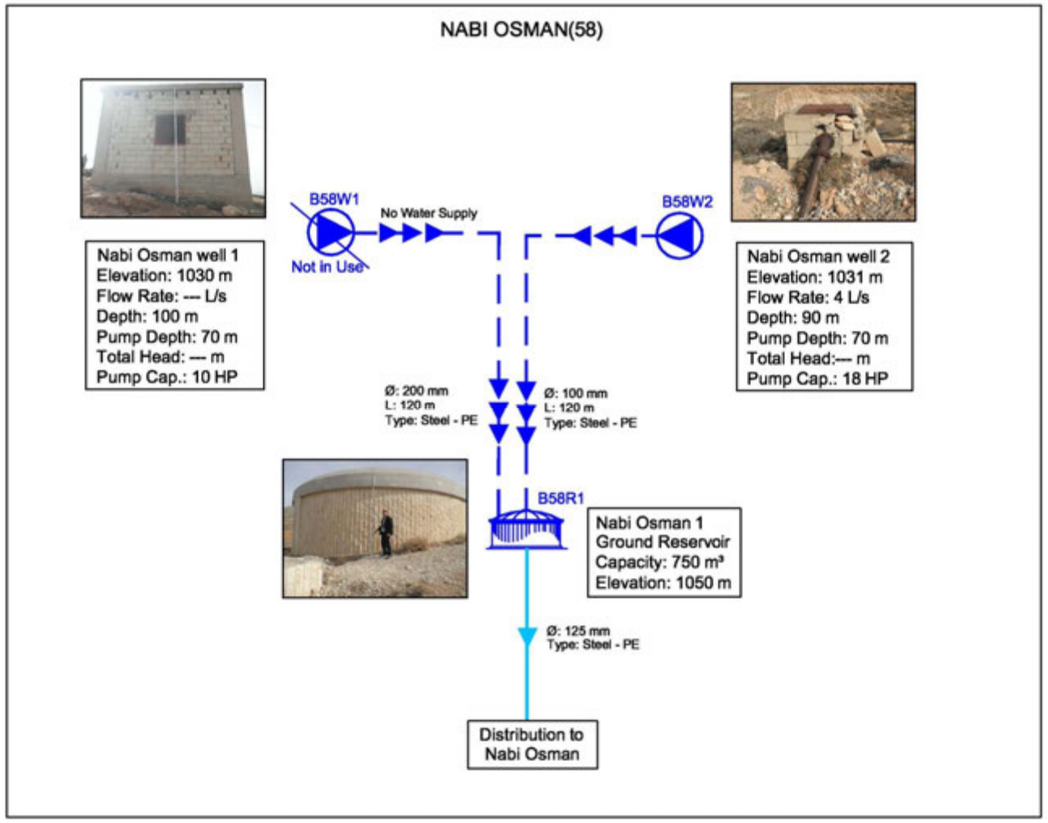
Well B57W3 (>15 years): Well is in good condition but it suffers from a shortage of electric power.

Well B57W4 (20 years old): Well is old and in bad condition. It is not in use anymore.

Reservoir B57R1 (2000 m³): Reservoir is new and it is in good condition. It has a chlorination unit.

Reservoir B57R2 (2x100 m³): Reservoir is very old but it is in an acceptable condition. This reservoir is not in use anymore. It needs rehabilitation.

Nabi Osman (58)



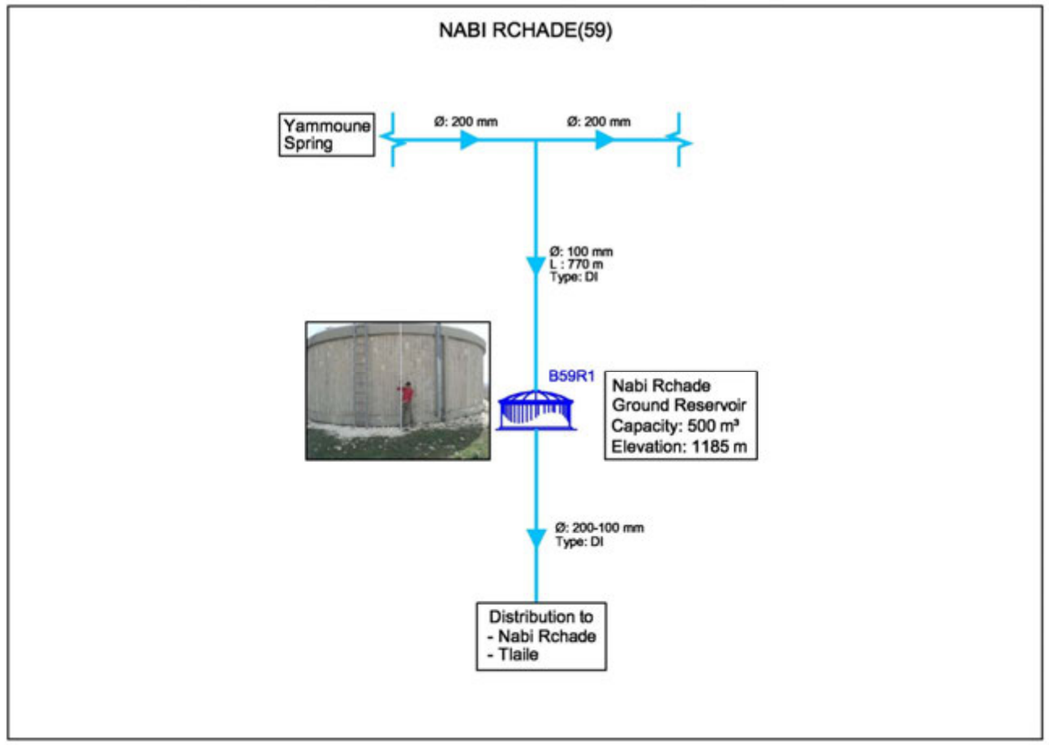
The existing water network is in very good condition and it has a length of around 23.5 km. It covers a large area of the town.

Well B58W1 (>10 years): Well is new but it is not in use.

Well B58W2: Well is in good condition but it suffers from water shortage depending on season. Its outlet pipe is rusted and needs to be changed.

Reservoir B58R1 (>10 years; 750 m³): Reservoir is in good condition.

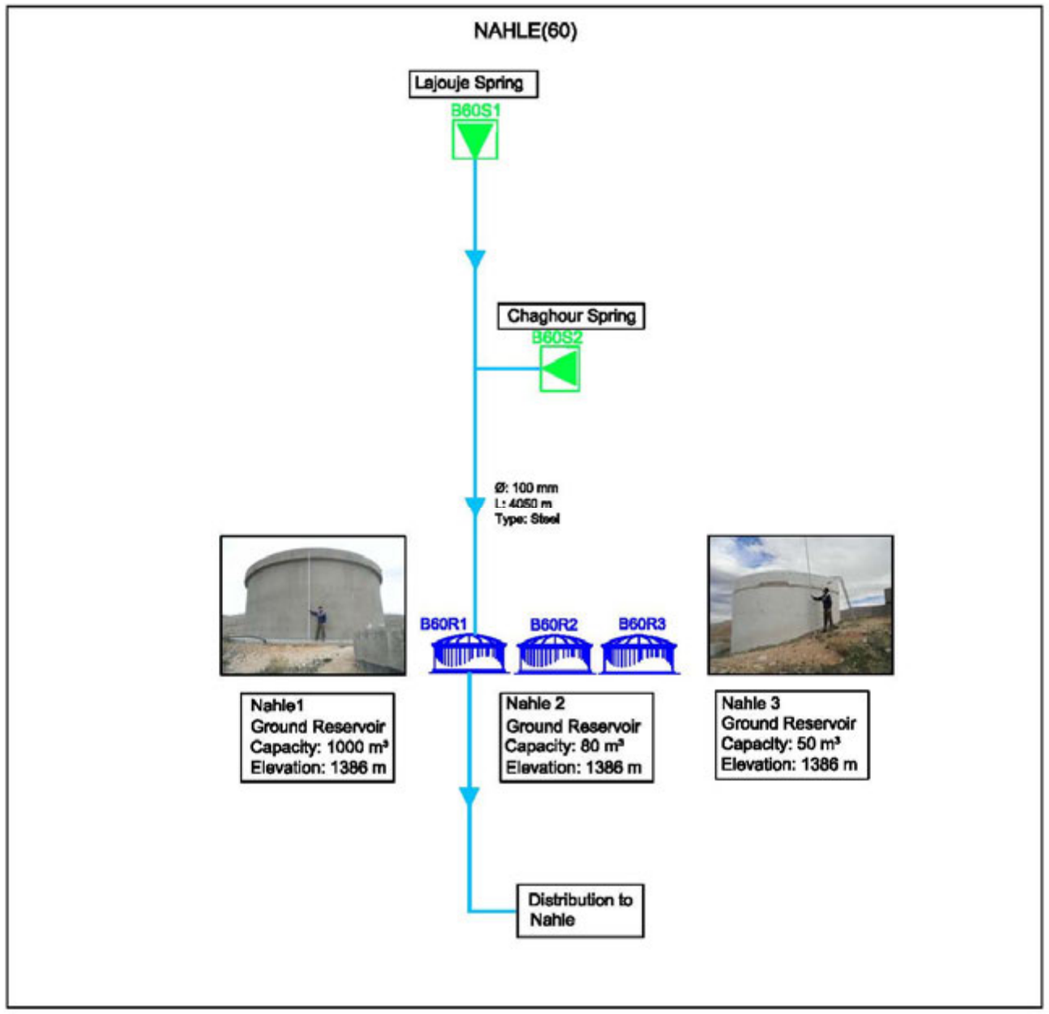
Nabi Rchade (59)



The existing water network is in good condition and it has a length of around 8 km. It covers a part of the town.

Reservoir B59R1 (>10 years; 500 m³): Reservoir is in good condition.

Nahle (60)



The existing water network is in good condition and it has a length of around 17 km. It covers a large area of the town.

Spring B60S1: No available information.

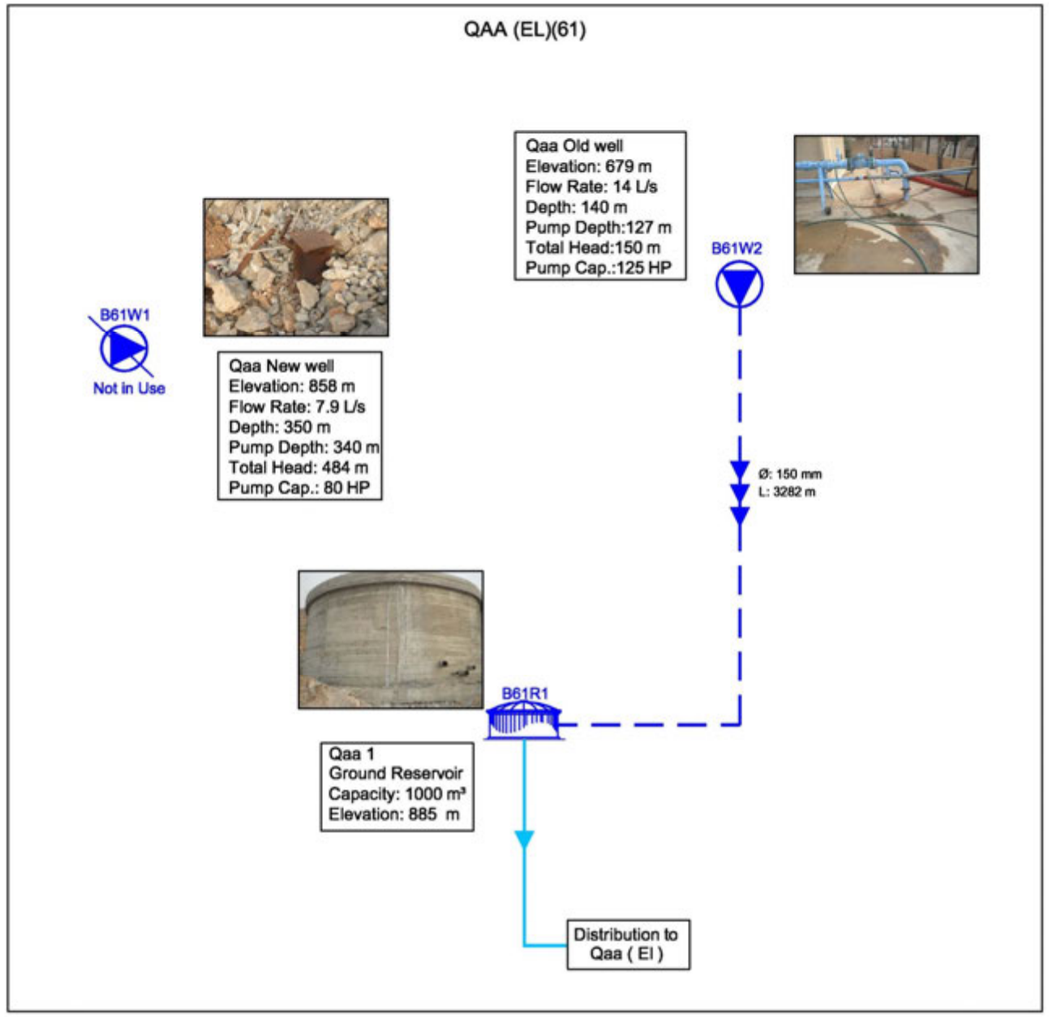
Spring B60S2: No available information.

Reservoir B60R1 (1000 m³): Reservoir is new and it is in good condition.

Reservoir B60R2 (80 m³): Reservoir is old but it is in an acceptable condition.

Reservoir B60R3 (50 m³): Reservoir is in good condition.

Qaa (El) (61)



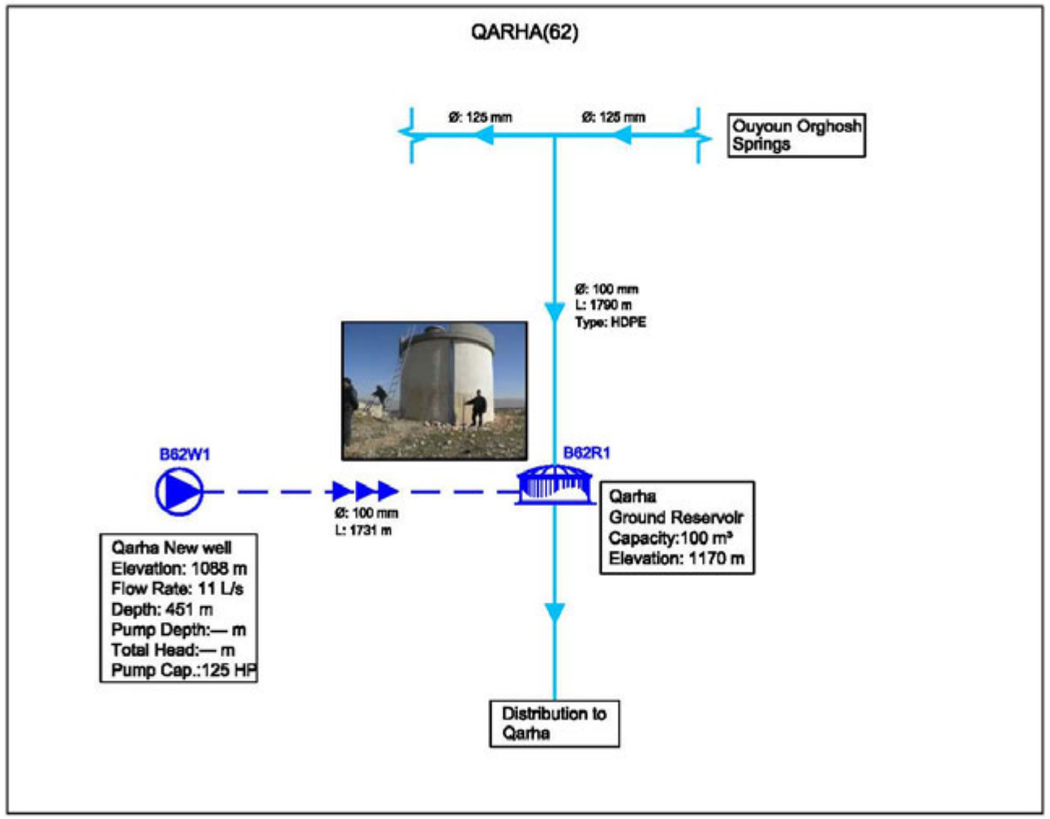
The existing water network is in good condition and it has a length of around 33.4 km. It covers a large area of the town.

Well B61W1 (<25 years): Well was still under construction during visit time. It is not in use.

Well B61W2 (35 years old): Well is old but it is in an acceptable condition. It suffers from a shortage of electric power.

Reservoir B61R1 (1000 m³): Reservoir is under construction during time visit. It will be supplied with water from B61W2 well in the near future.

Qarha (62)

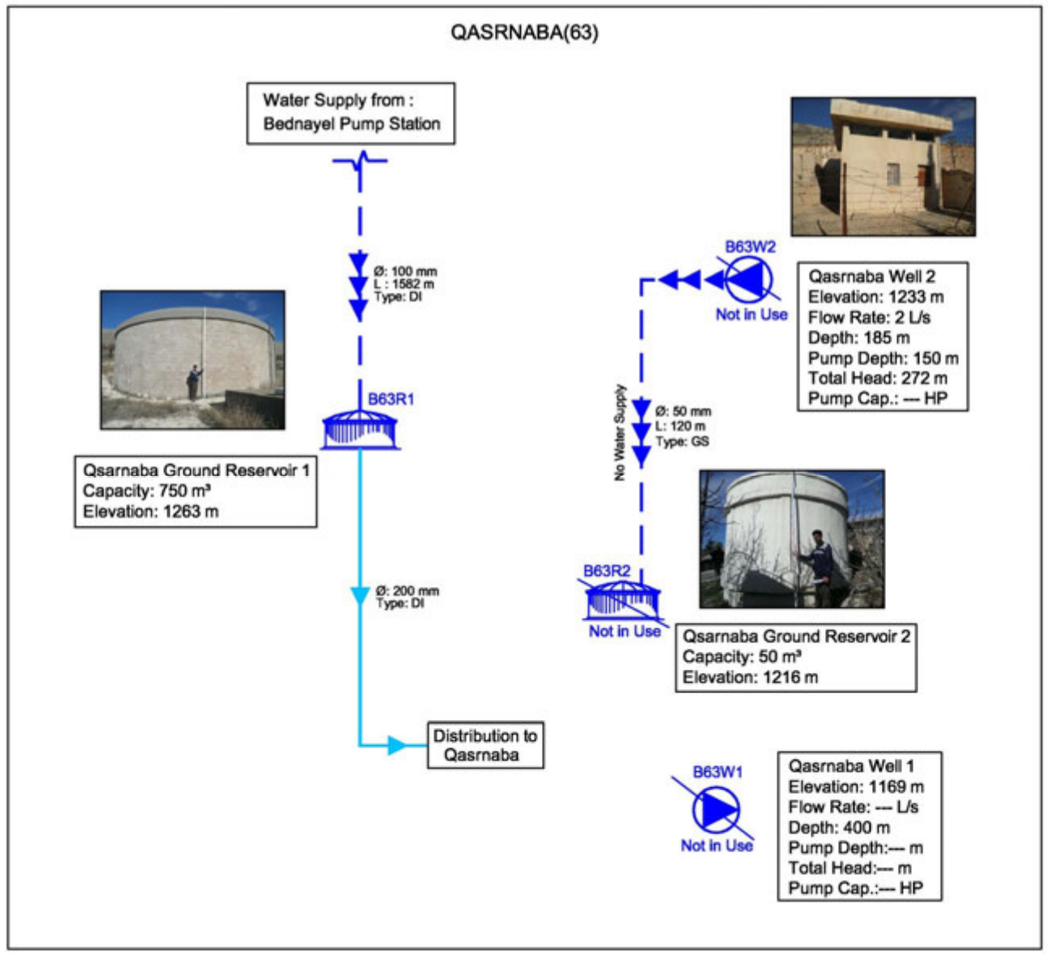


The existing water network is in medium condition and it has a length of around 3.6 km. It covers a part of the town.

Reservoir B62R1 (>10 years; 100 m³): Reservoir is in good condition.

Well B62W1 (<2 years): Well is new and it is in very good condition.

Qasrnaba (63)



The existing water network is in medium condition and it has a length of around 16.4 km. It covers a large area of the town

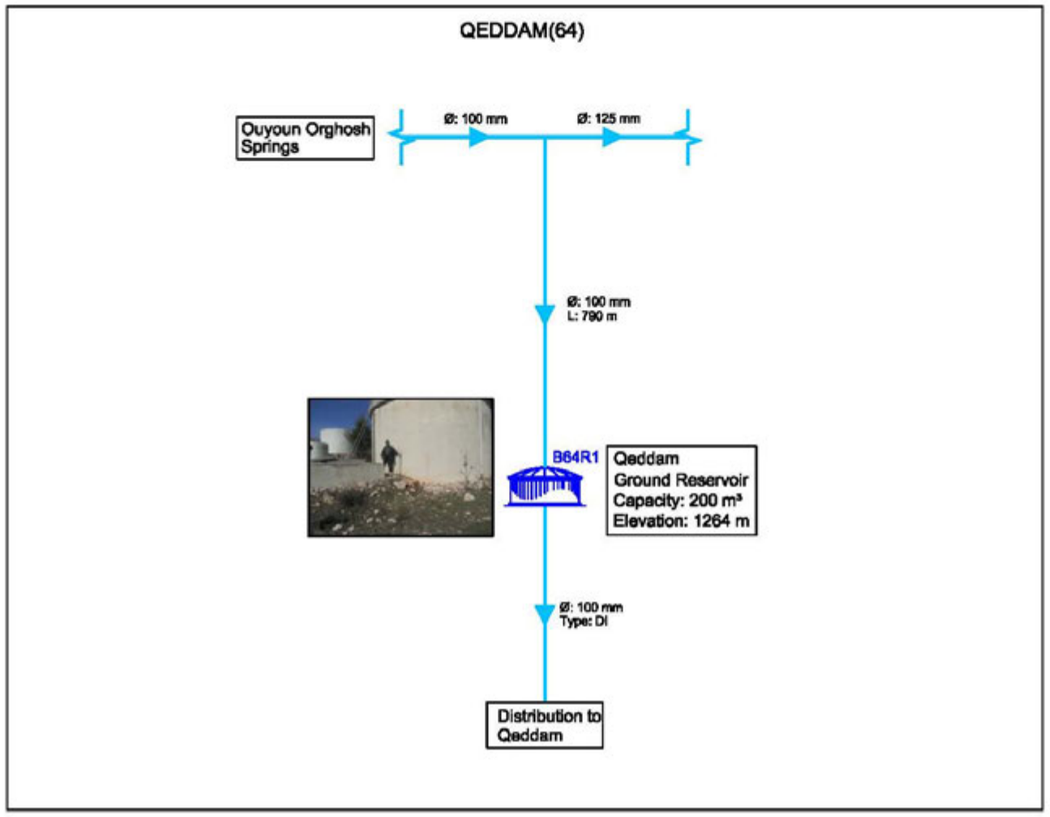
Well B63W1 (<5 years): Well is new but it is not in use.

Well B63W2 (30 years old): Well is very old and dry. It is not in use.

Reservoir B63R1 (>10 years; 750 m³): Reservoir is in good condition.

Reservoir B63R2 (20 years old; 50 m³): Reservoir is in good condition but it is not in use.

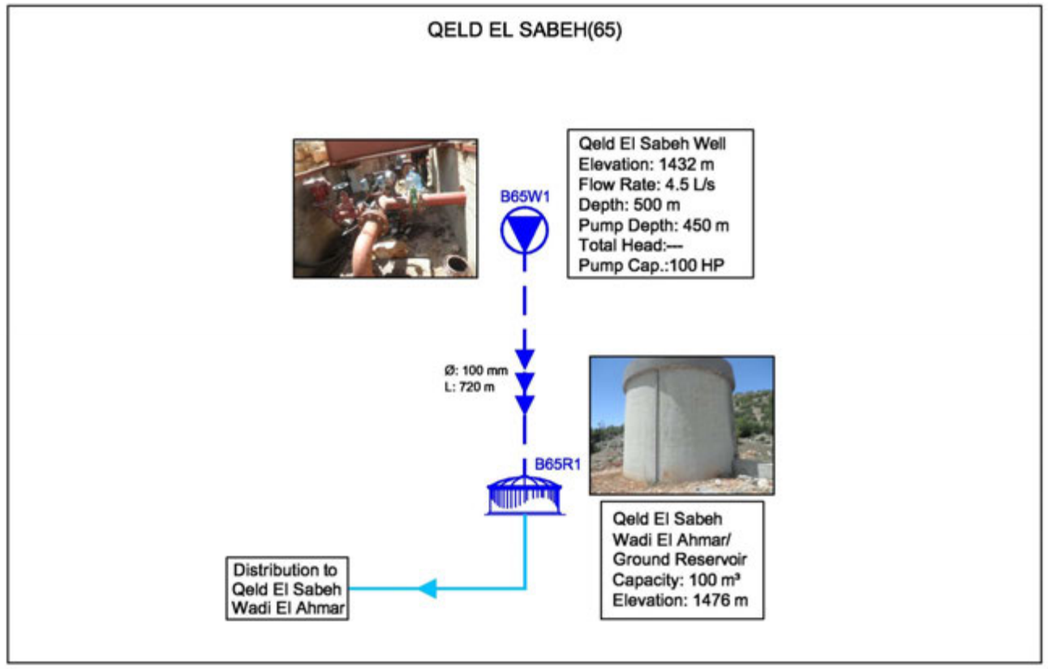
Qeddam (64)



The existing water network is in good condition and it has a length of around 5.3 km. It covers a large area of the town.

Reservoir B64R1 (>10 years; 200 m³): Reservoir is in good condition.

Qeld El Sabeh (65)

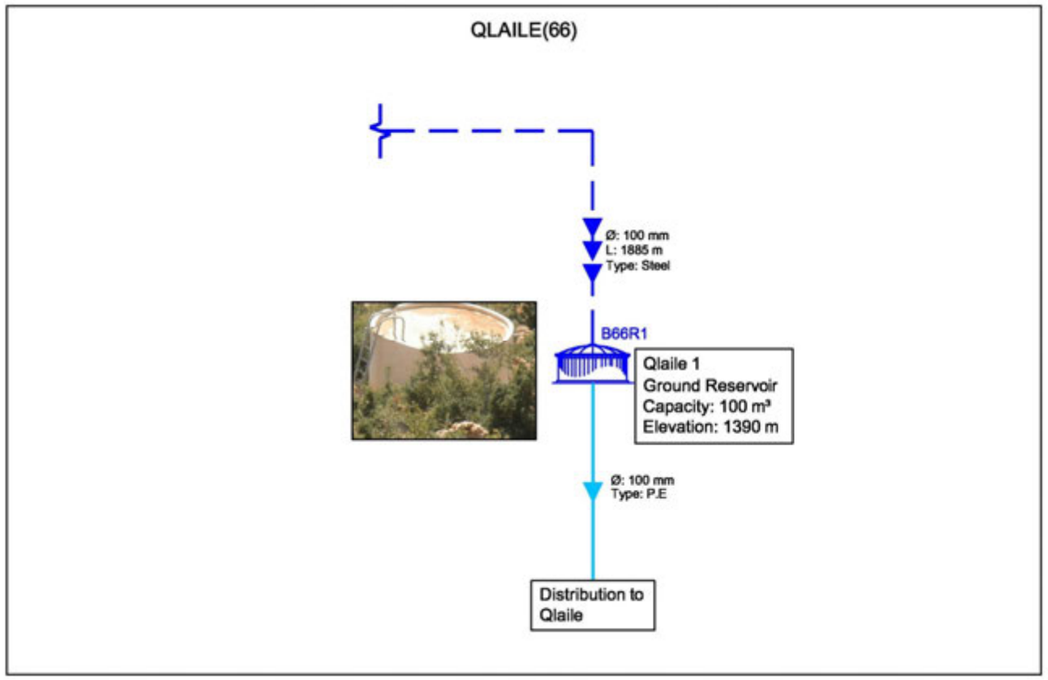


The existing water network of Qeld El Sabeh, Ramassa and Beit Mcheik is in bad condition and it has a length of around 4.6 km. It covers a large area of the three towns.

Well B65W1 (15 years old): Well is in good condition but it suffers from a shortage of electric power. This well is not under the supervision and operation of BWE; rather the municipality operates it.

Reservoir B65R1 (100 m³): Reservoir is in good condition.

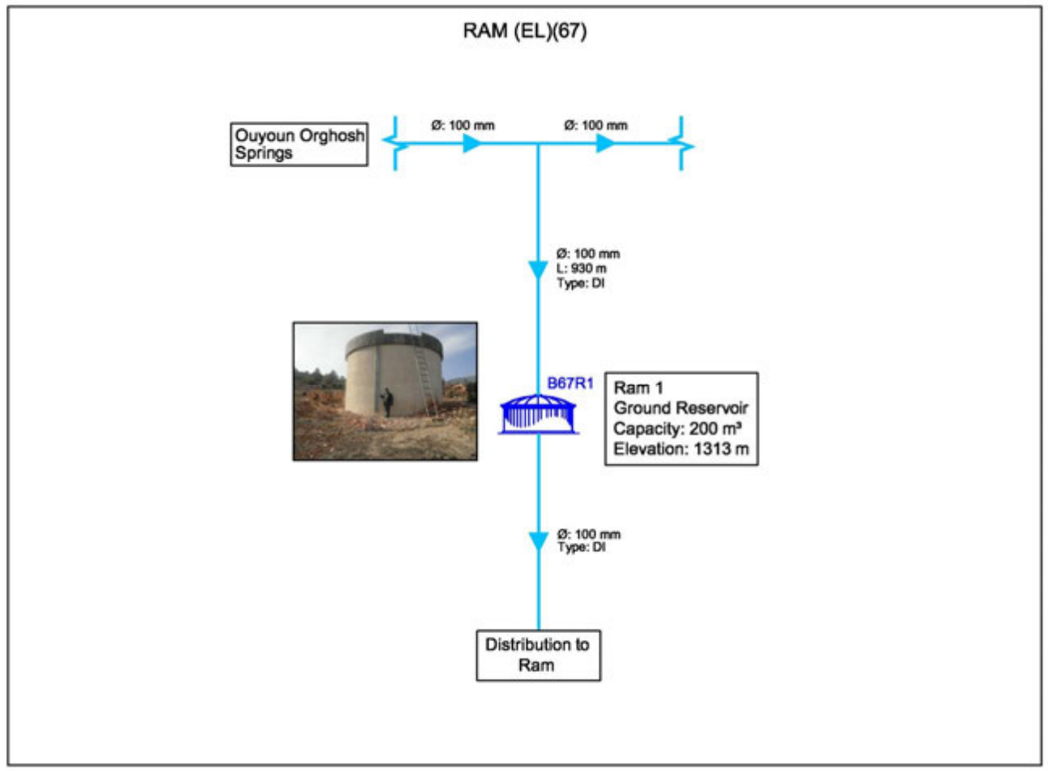
Qlaile (66)



There is no available information concerning the water network of the town.

Reservoir B66R1 (15 years old; 100 m³): No available information concerning this reservoir. However, there is a non-used old small reservoir next to b66r1.

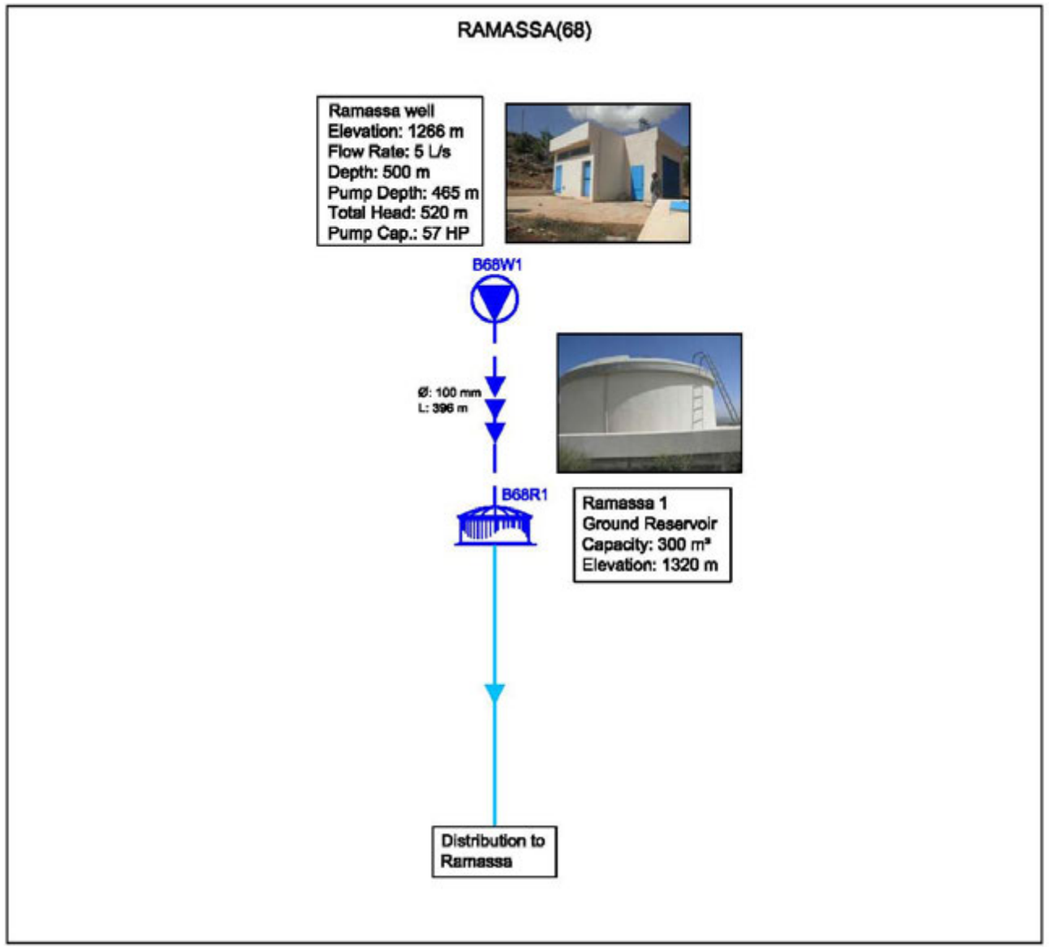
Ram (el) (67)



The existing water network is in good condition and it has a length of around 5.5 km. It covers a part of the town.

Reservoir B67R1 (>10 years; 200 m³): Reservoir is in good condition.

Ramassa (68)

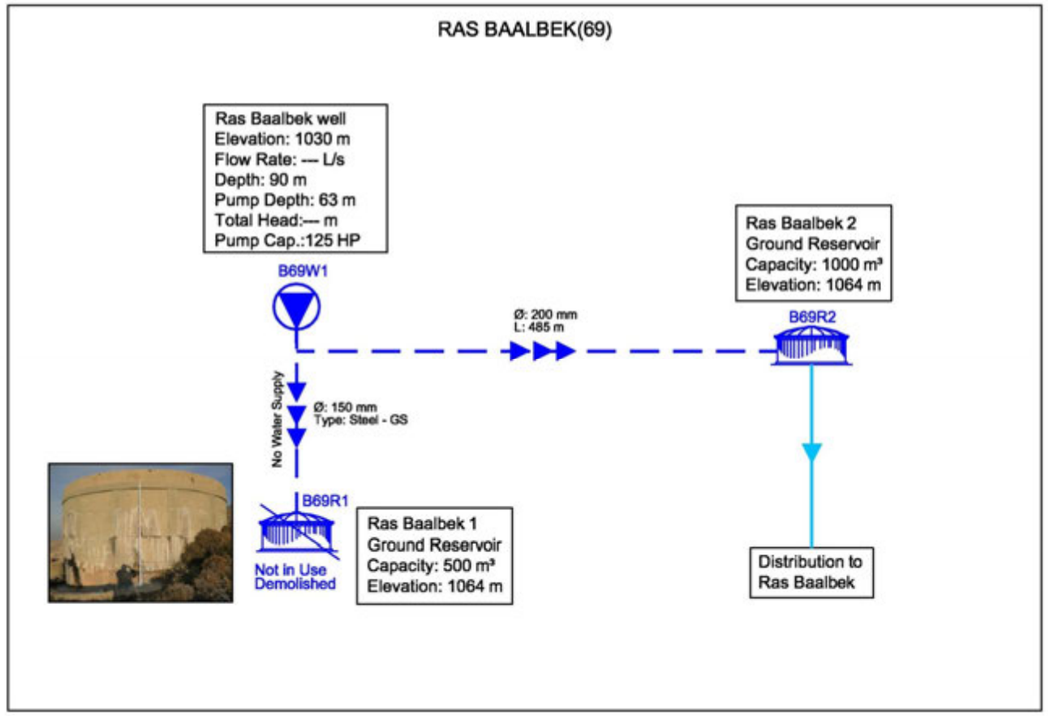


The existing water network of ramassa is in bad condition. It covers a large area of the three towns.

Well B68W1 (<5 years): Well is in good condition but it suffers from lack of water.

Reservoir B68R1 (5 years old; 300 m³): Reservoir is in good condition.

Ras Baalbek (69)



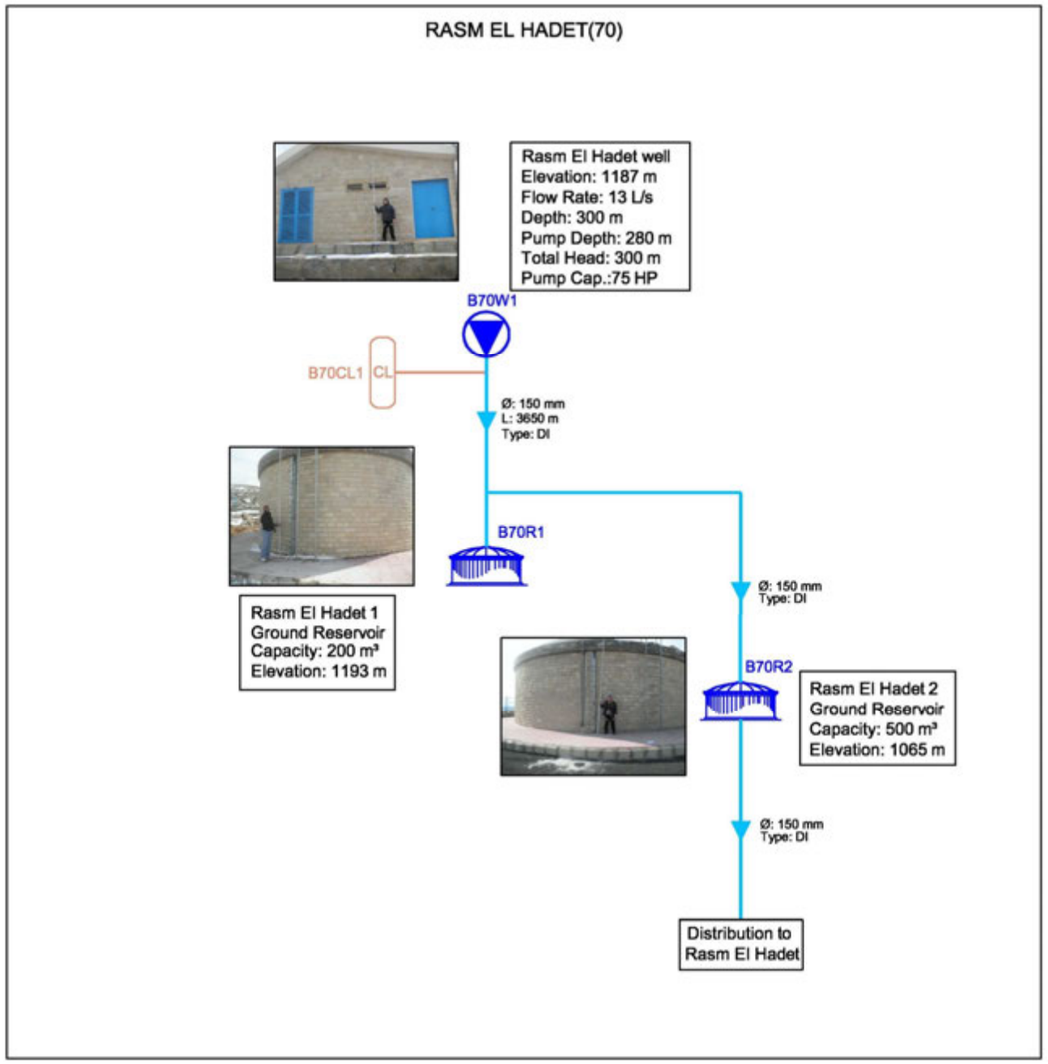
The existing water network is in bad condition and it has a length of around 20.3km. It covers a large area of the town.

Well B69W1 (25 years old): No available information.

Reservoir B69R1 (55 years old; 500 m³): Reservoir is in bad condition. It needs esthetical and structural rehabilitation or reconstruction. The pipes and valves are rusted they needs maintenance. This reservoir is not in use and it may be destroyed.

Reservoir B69R2 (< 2 years old; 1000 m³): This reservoir is new and it is in very good condition.

Rasm El Hadet (70)



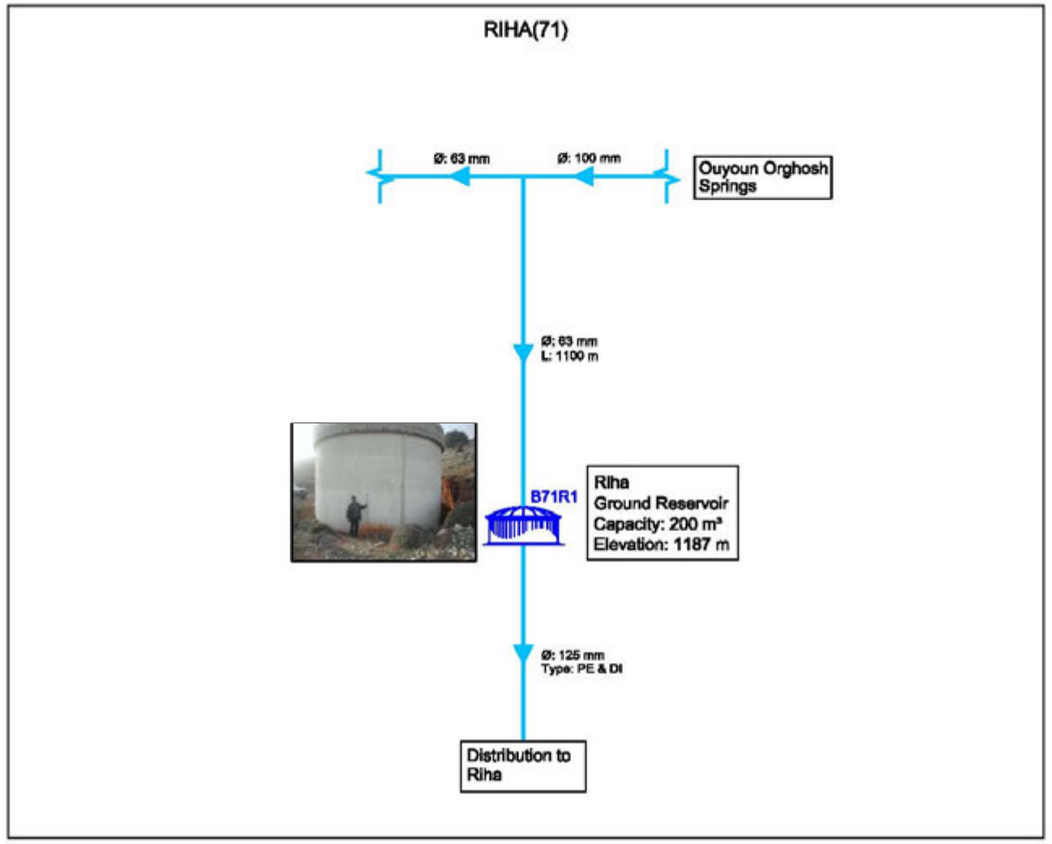
There is no available information concerning the water network of the town.

Well B70W1 (5 years old): Well is new and it is in good condition. This well has a power generator.

Reservoir B70R1 (5 years old; 200 m³): Reservoir is in good condition.

Reservoir B70R2 (5 years old; 500 m³): Reservoir is in good condition.

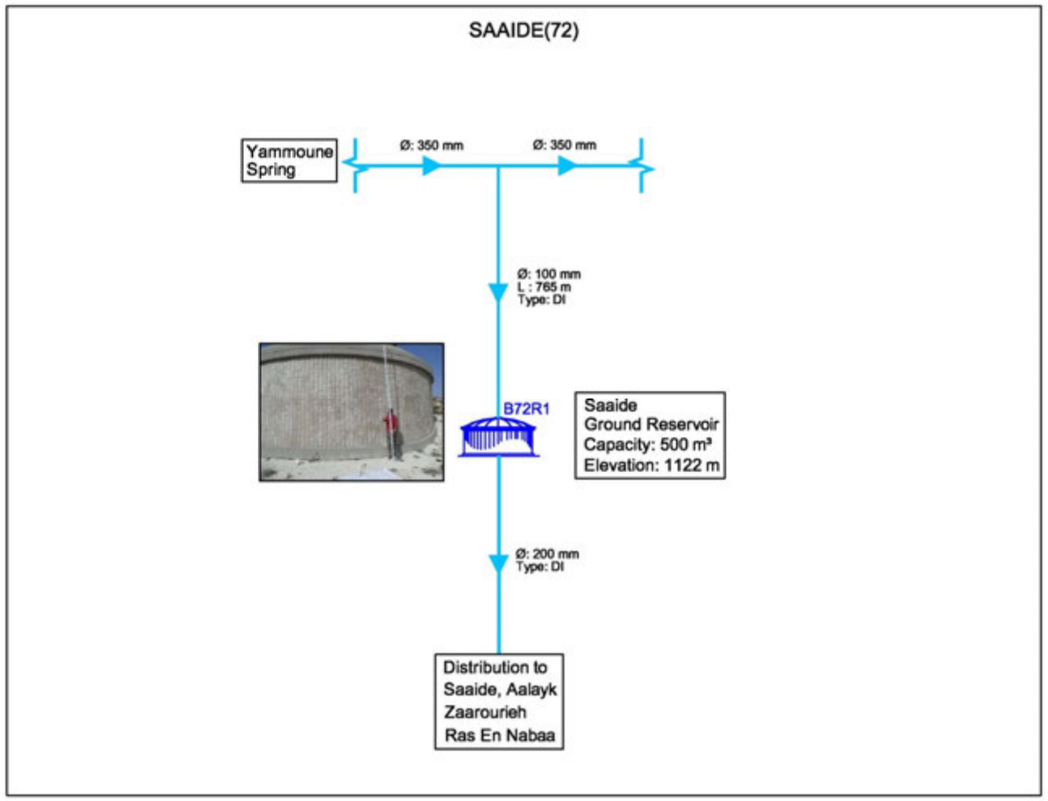
Riha (71)



The existing water network is in good condition and it has a length of around 3.8 km. It covers a large area of the town.

Reservoir B71R1 (>10 years; 200 m³): Reservoir is in good condition.

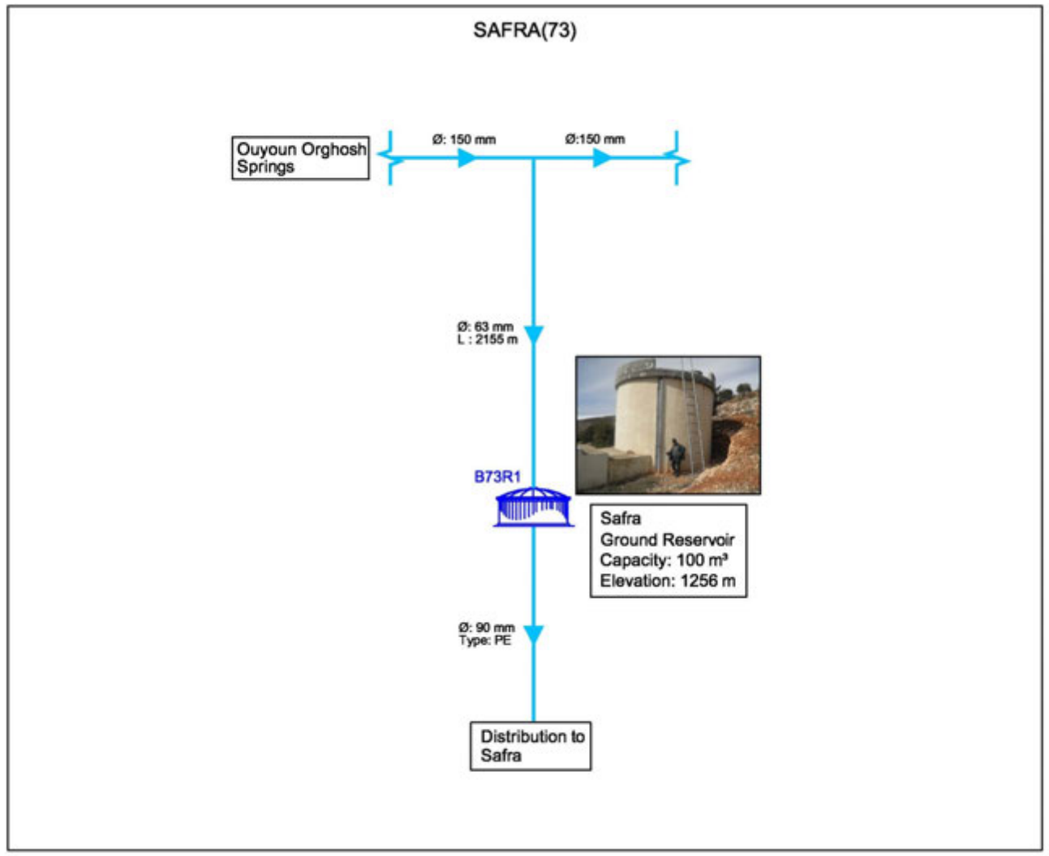
Saaide (72)



The existing water network is in good condition and it has a length of around 15.2 km. It covers a large area of the town.

Reservoir B72R1 (>10 years; 500 m³): Reservoir is in good condition.

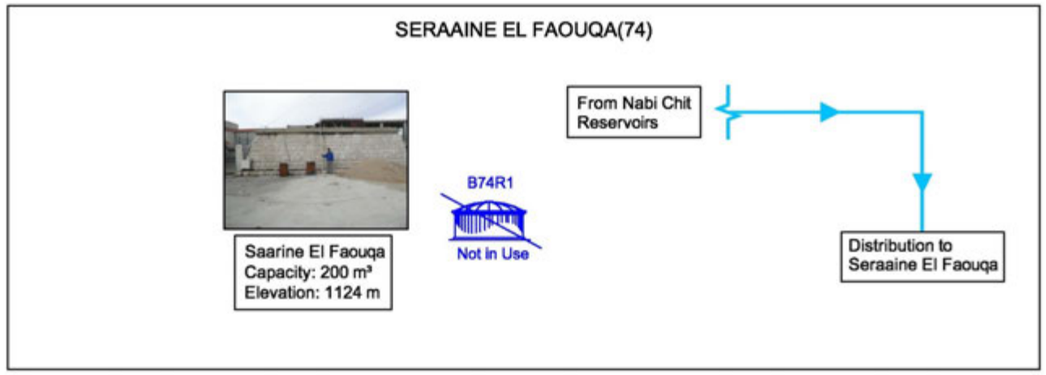
Safra (73)



The existing water network is in good condition and it has a length of around 3.5 km. It covers a large area of the town.

Reservoir B73R1 (>10 years; 100 m³): Reservoir is in good condition.

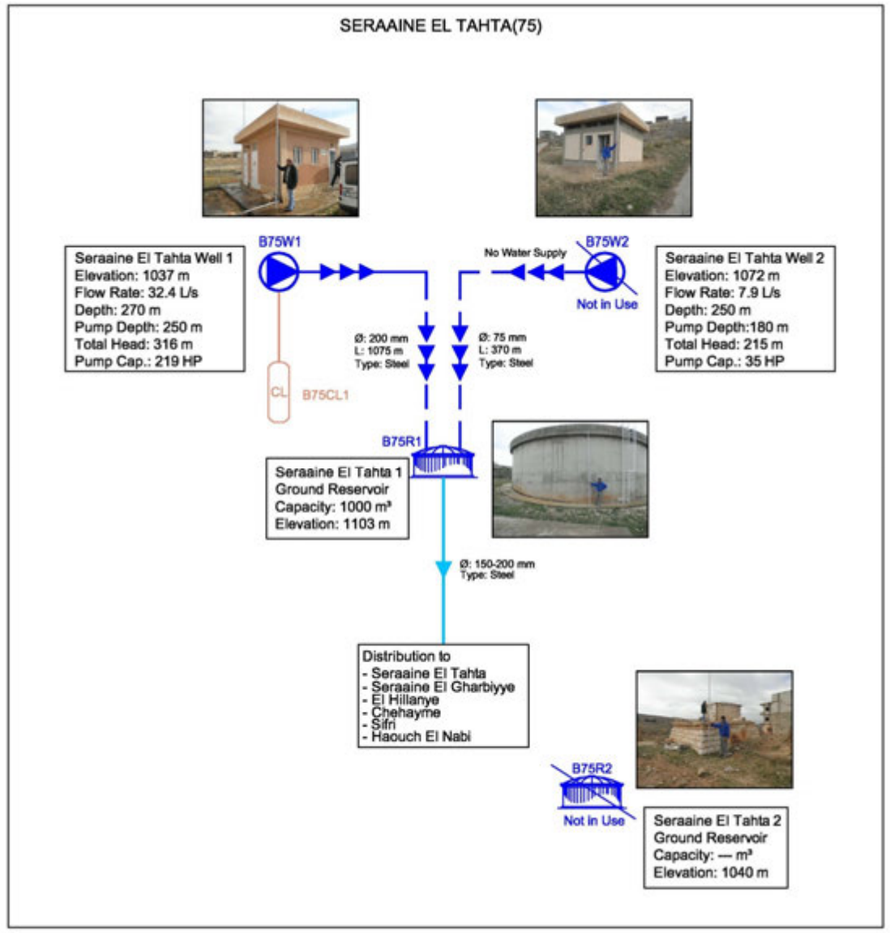
Seraaine El Faouqa (74)



There is no available information concerning the water network of the town.

Reservoir B74R1 (>10 years; 200 m³): Reservoir is very old but it is in an acceptable condition. This reservoir is not in use.

Seraaine El Tahta (75)



The existing water network is in good condition and it has a length of around 83 km. It covers a large area of the town.

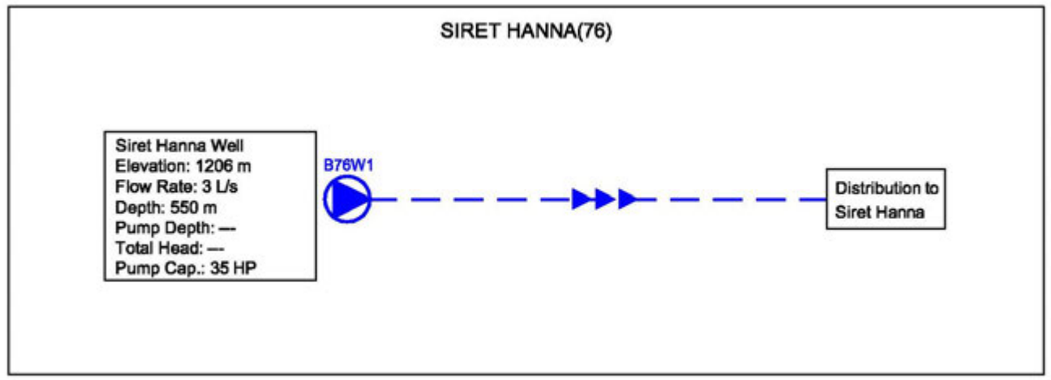
Well B75W1: Well is in good condition but it suffers from a shortage of electric power. It has a chlorination unit and a power generator.

Well B75W2: Well is in bad condition and is not in use. Its outlet pipe is rusted.

Reservoir B75R1 (1000 m³): Reservoir is in good condition.

Reservoir B75R2: Reservoir is very old and it is in bad condition. It needs esthetical and structural rehabilitation. The pipes and valves are rusted and they need maintenance. It is not in use.

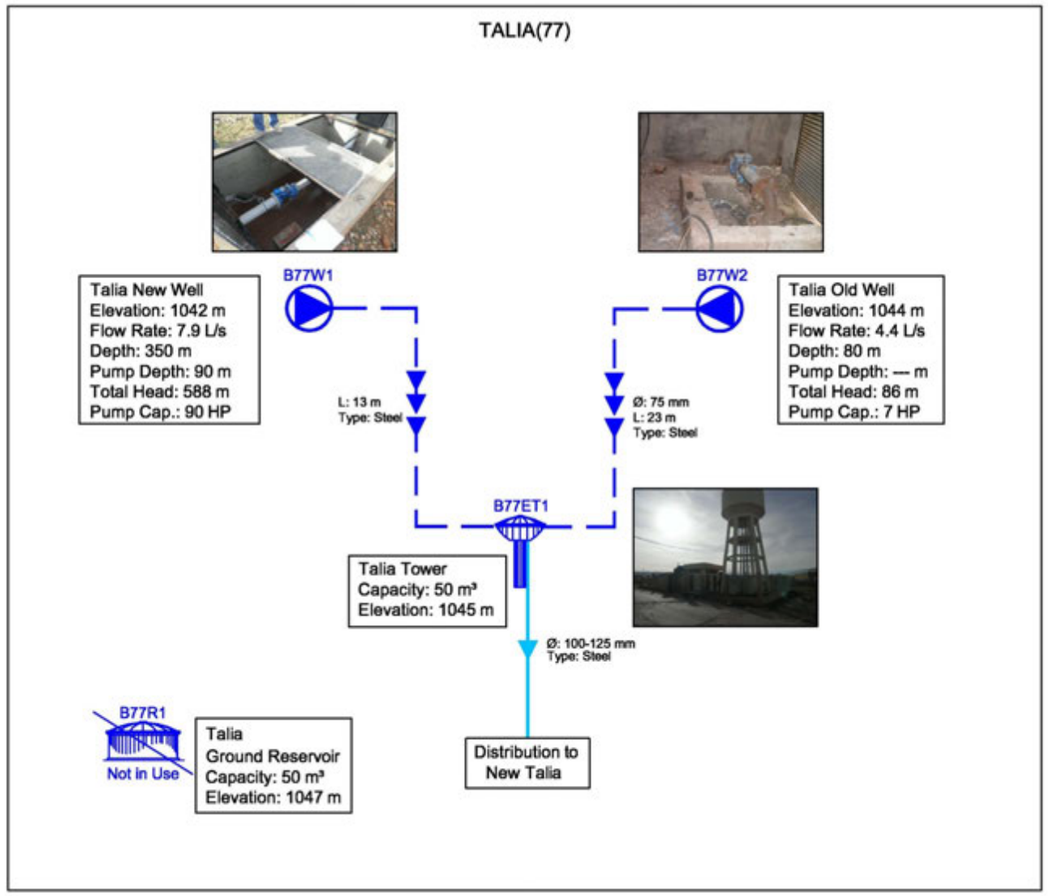
Siret Hanna (76)



There is no available information concerning the water network of the town.

Well B76W1 (< 2years): Well is new and it is in good condition.

Talia (77)



The existing water network is in very good condition and it has a length of around 19 km. It covers a large area of the town.

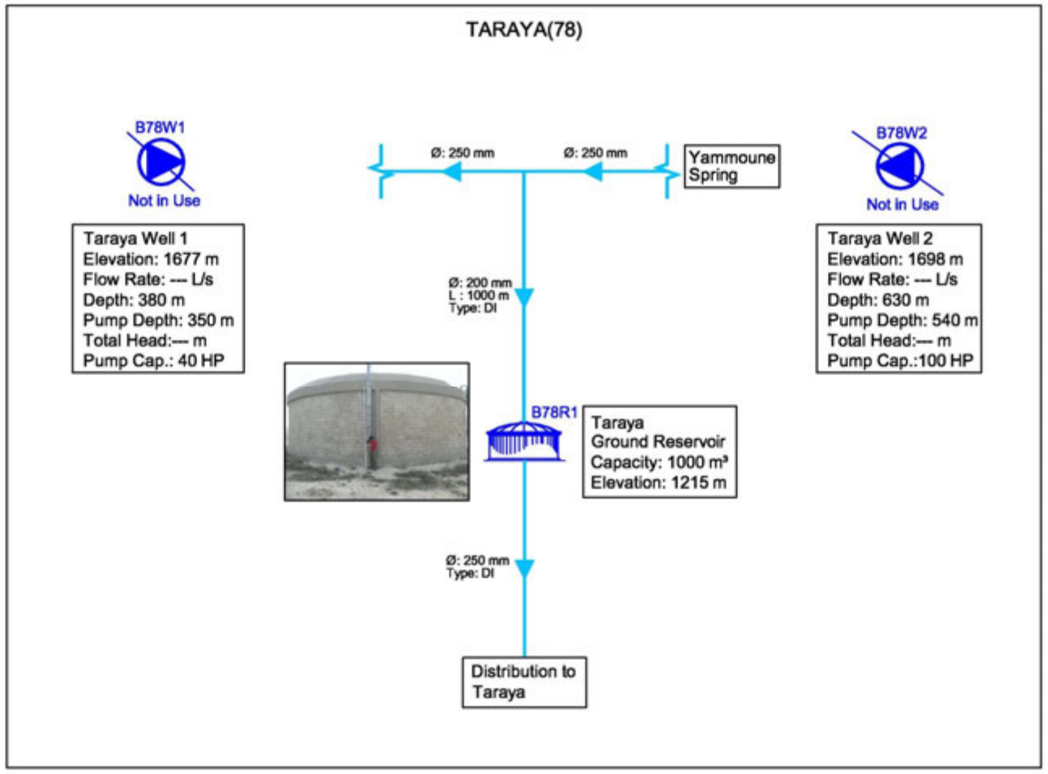
Well B77W1 (15 years old): Well is in good condition but it suffers from a shortage of electric power.

Well B77W2: Well is old and it is in bad condition. It suffers from a shortage of electric power. This well needs rehabilitation.

Reservoir B77R1 (50 m³): Reservoir is very old and it is in bad condition. It is not in use. This reservoir needs rehabilitation or reconstruction.

Elevated tank B77ET1 (50 m³): Elevated tank is in good condition.

Taraya (78)



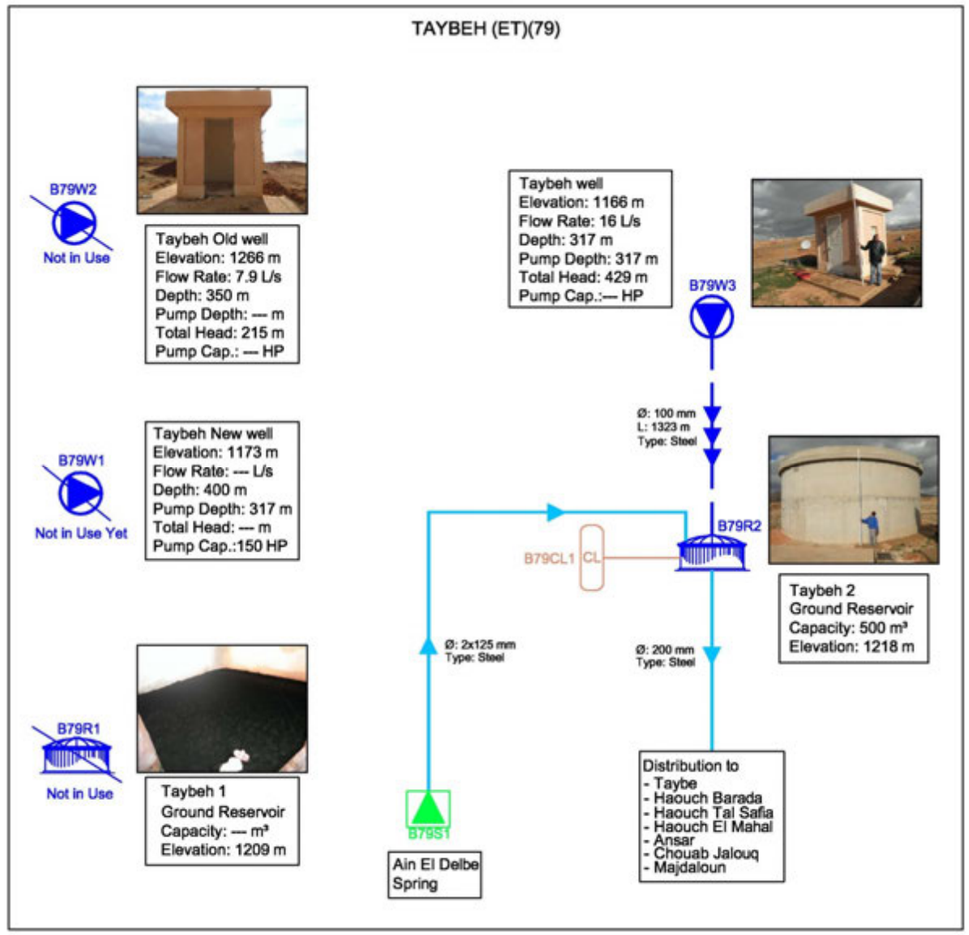
The existing water network is in good condition and it has a length of around 28 km. It covers a large area of the town.

Well B78W1 (>5 years): Well is not in use.

Well B78W2 (5 years old): Well is not in use.

Reservoir B78R1 (>10 years; 1000 m³): Reservoir is in good condition.

Taybeh (El) (79)



The existing water network is in good condition and it has a length of around 20 km. It covers a large area of the town.

Well B79W1 (15 years old): Well is new and it is in good condition but it is not in use yet.

Well B79W2 (>15 years): Well is in bad condition and it is not in use.

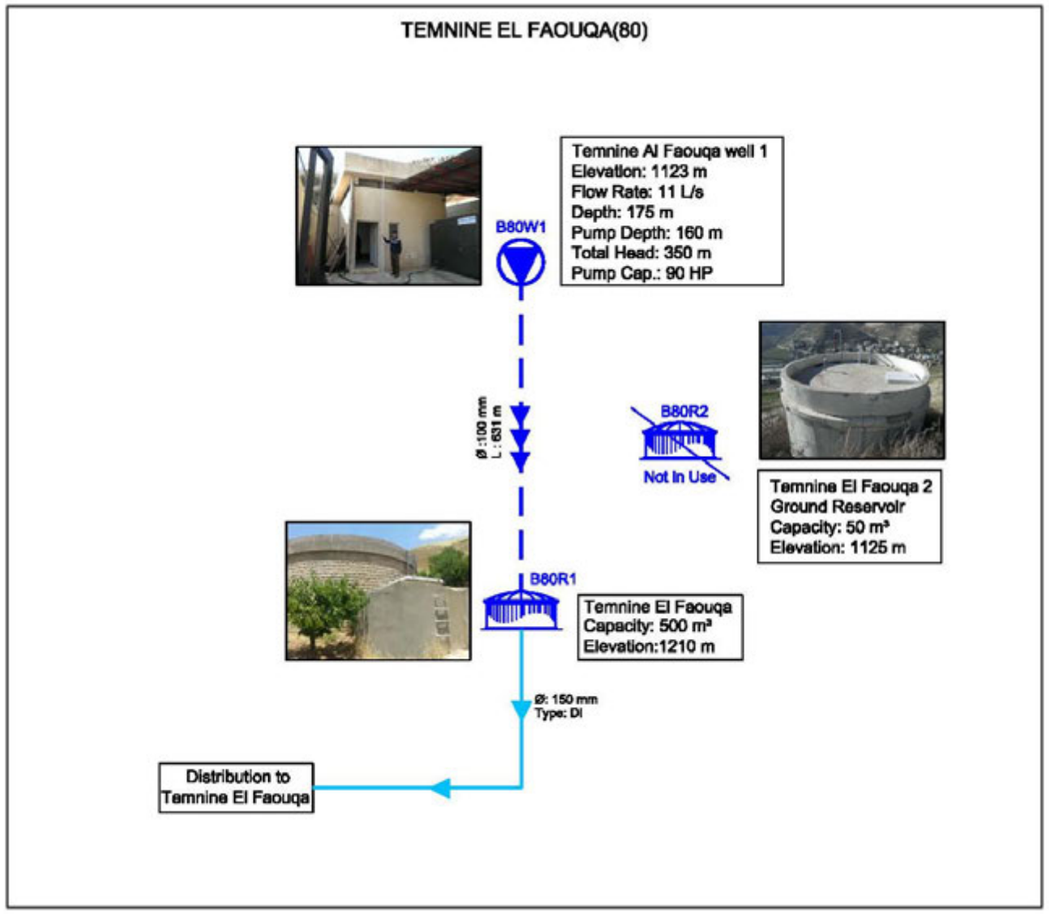
Well B79W3: Well is in good condition. It has a power generator.

Reservoir B79R1: Reservoir is very old and it is in bad condition. It needs esthetical and structural rehabilitation or reconstruction. The pipes and valves are rusted and they need maintenance. It is not in use.

Reservoir B79R2 (500 m³): Reservoir is in good condition but its indoor panel of water level indicator is missing.

Spring B79S1: Spring is coming from mountains. No more available information.

Temnine El Faouqa (80)



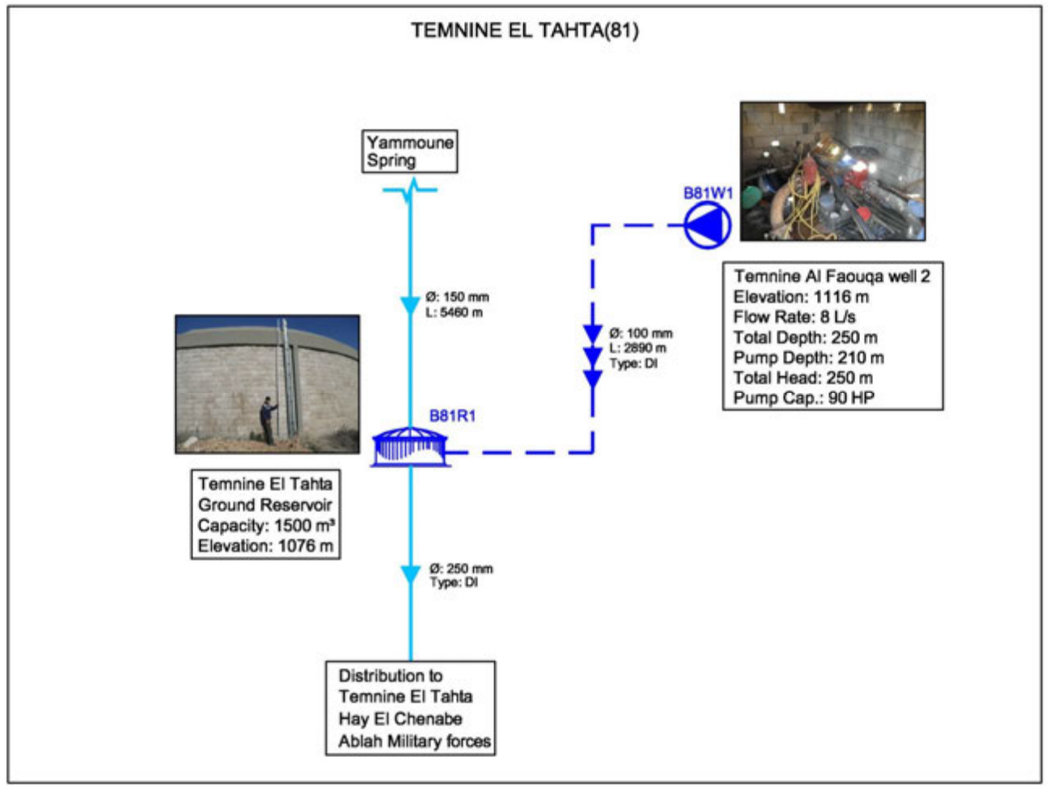
The existing water network is in good condition and it has a length of around 17 km. It covers a large area of the town.

Well B80W1 (>25 years): Well is in good condition. However, the chlorinator is not working due to leakage in the water pipe connection and the water is delivered without filtration or treatment so the water needs filtration especially in winter times due to turbulence. Also, the building needs rehabilitation especially for the control room but it is operational. The generator set is supplied with fuel from the municipality only during electrical blackouts.

Reservoir B80R1 (500 m³): Reservoir is in good condition.

Reservoir B80R2 (>10 years; 50 m³): Reservoir is in bad condition and it is not in use. It needs rehabilitation.

Temnine El Tahta (81)

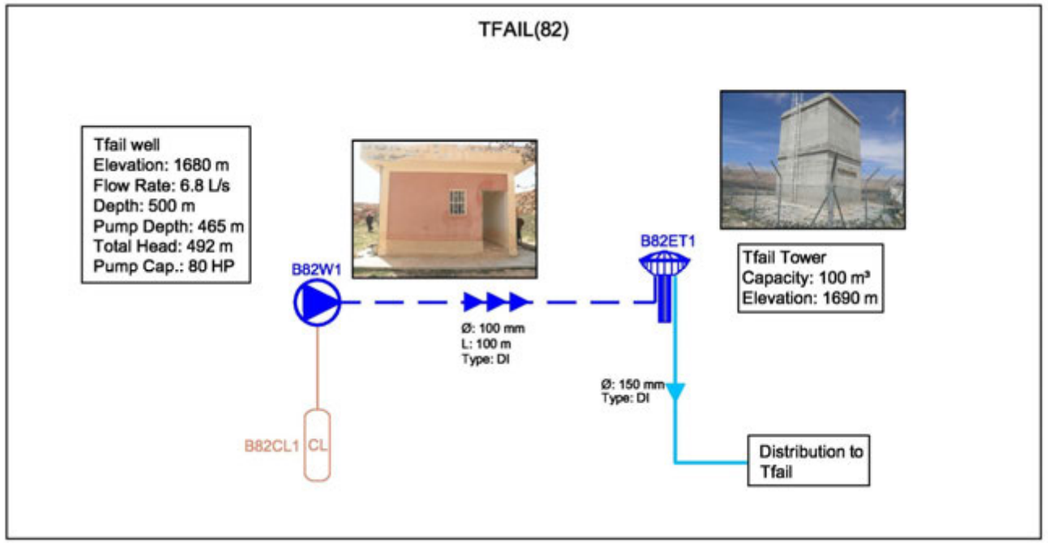


The existing water network is in good condition and it has a length of around 17.3 km. It covers a large area of the town.

Well B81W1 (15 years old): Well is in bad condition. Pipes and valves shall be changed.

Reservoir B81R1 (>10 years; 1500 m³): Reservoir is in good condition.

Tfail (82)

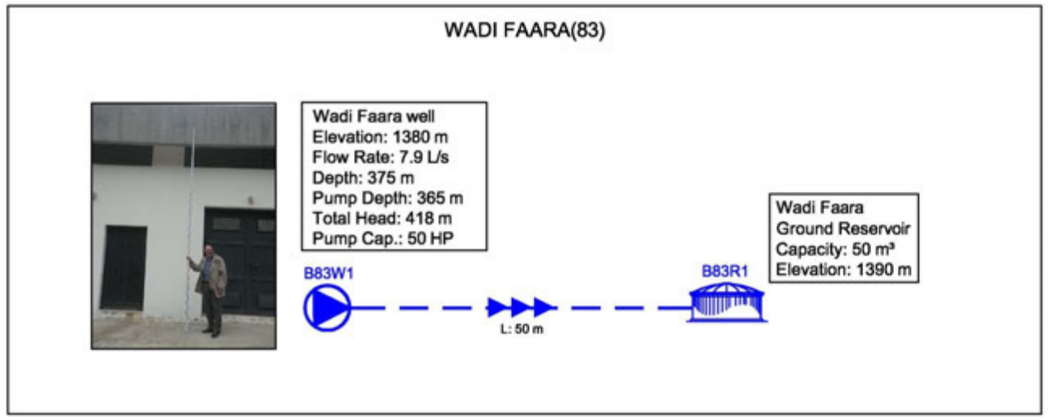


The existing water network is in good condition and it has a length of around 6 km. It covers a large area of the town.

Well B82W1 (>10 years): Well is not accessible but it is in use. This village cannot be reached from Lebanon.

Elevated tank B82ET1 (>10 years; 100 m³): Elevated tank is new and it is in good condition.

Wadi Faara (83)

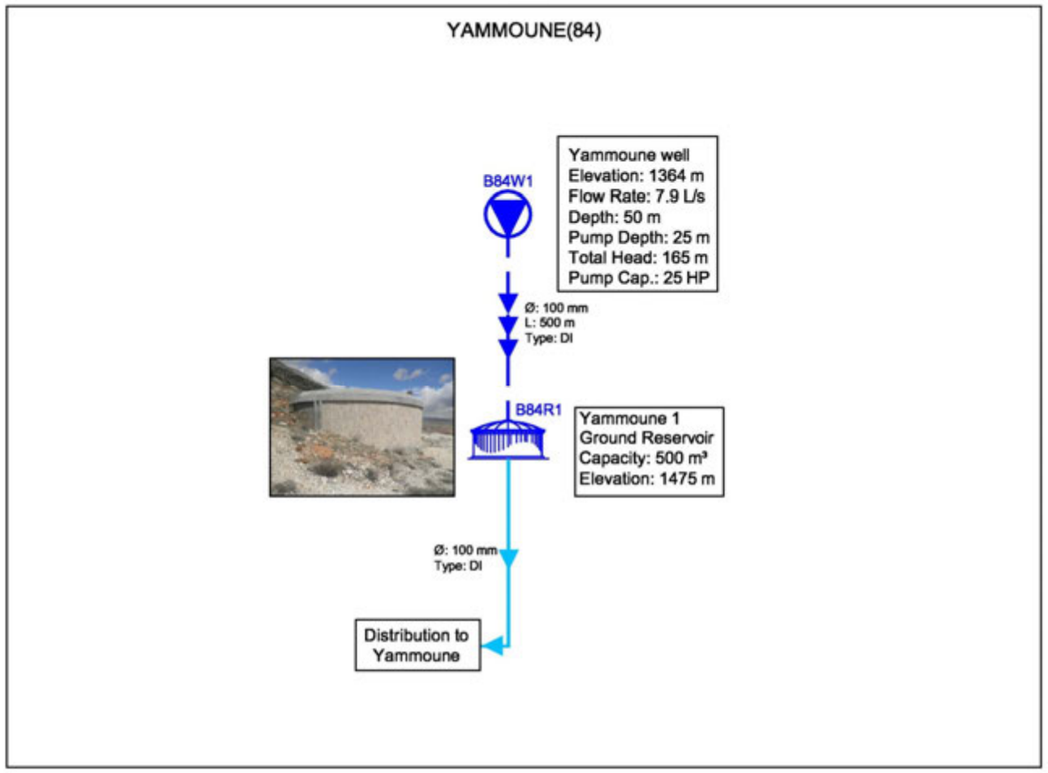


There is no available information concerning the water network of the town.

Well B83W1 (20 years old): Well is in an acceptable condition. No available information.

Reservoir B83R1 (50 m³): No available information.

Yammoune (84)

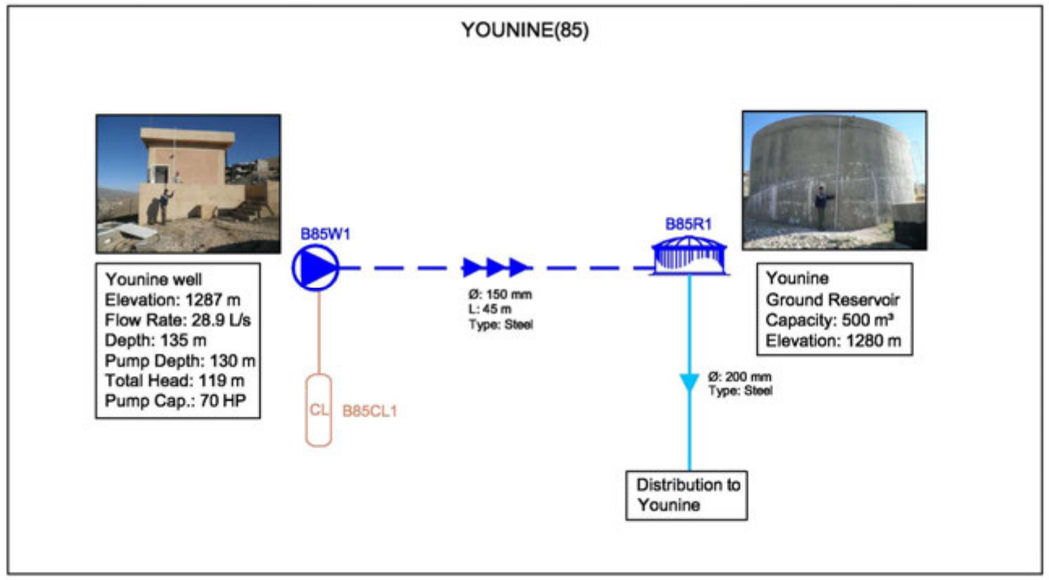


The existing water network is in good condition and it has a length of around 7.6 km. It covers a large area of the town.

Well B84W1 (20 years old): Well is in good condition.

Reservoir B84R1 (10 years old; 500 m³): Reservoir is in good condition but it is not in use because there is no water source.

Younine (85)

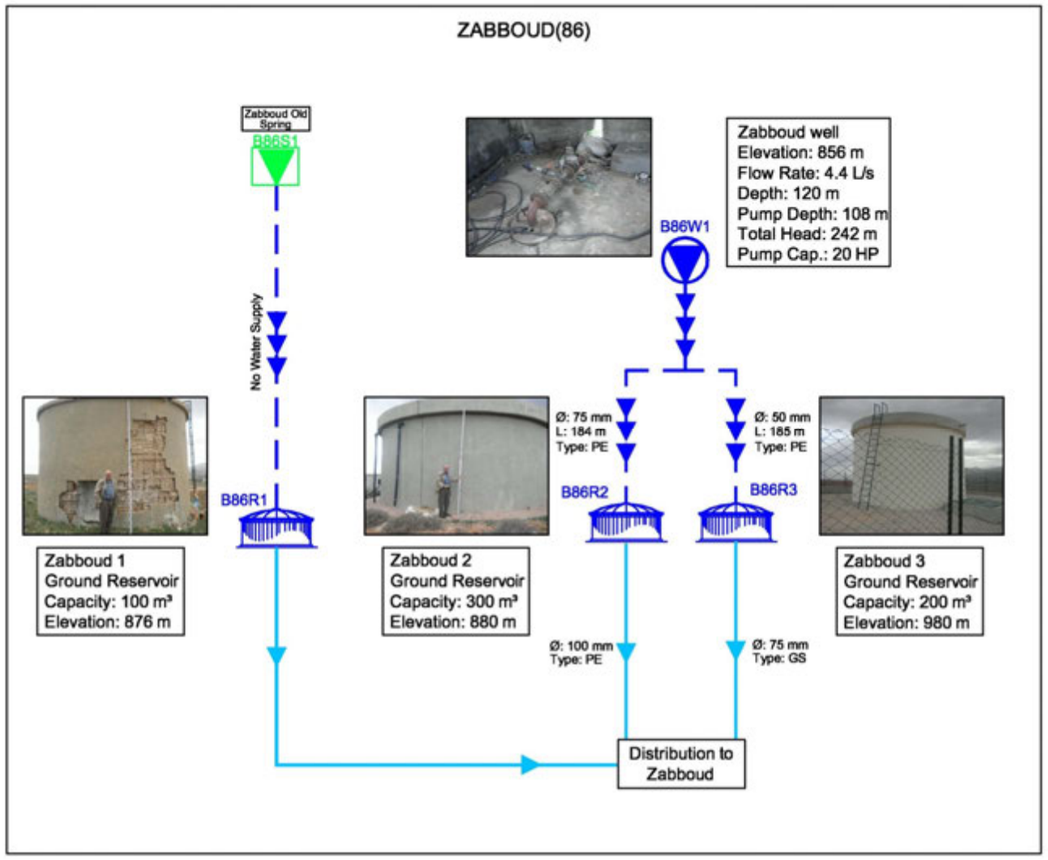


The existing water network is in good condition and it has a length of around 38 km. It covers a large area of the town.

Well B85W1 (20 years old): Well is in good condition. It has new power generator.

Reservoir B85R1 (>10 years; 500 m³): Reservoir is in good condition.

Zabboud (86)



The existing water network is 40 years old and it is in bad condition.

Well B86W1 (45 years old): Well is in bad condition but it suffers from a shortage of electric power. Its building needs rehabilitation. Pipes and valves are rusted and they need to be changed. This well needs rehabilitation.

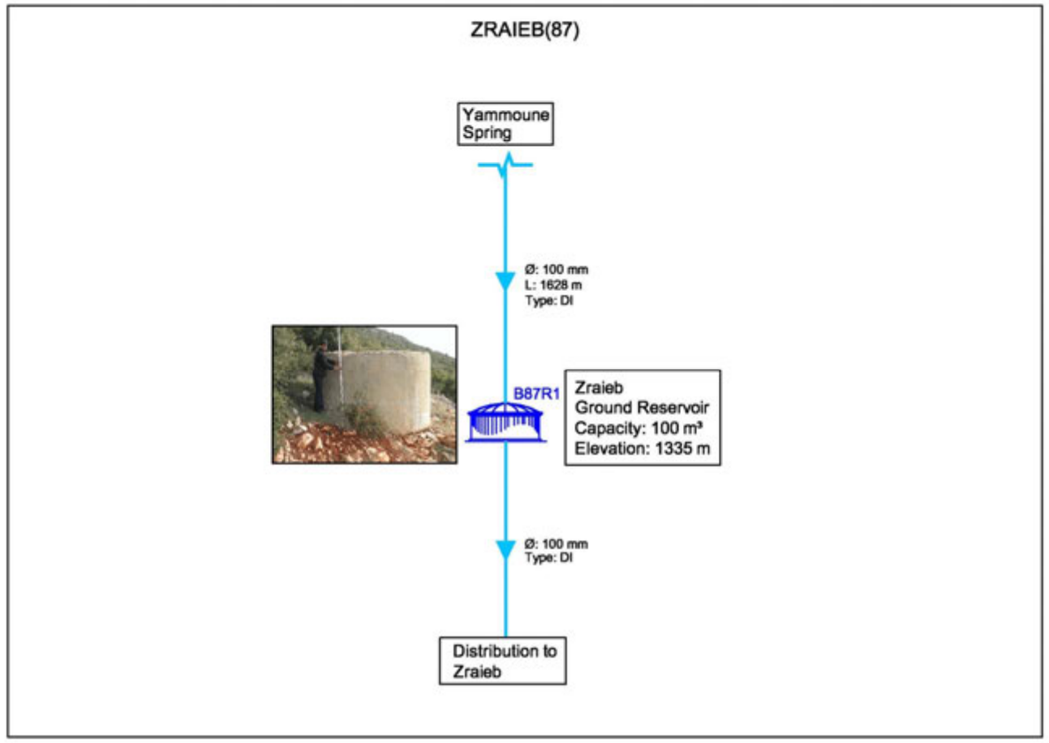
Spring B86S1: No available information.

Reservoir B86R1 (50 years old; 100 m³): Reservoir is in bad condition. It needs esthetical and structural rehabilitation or reconstruction. The pipes and valves are rusted and they need maintenance.

Reservoir B86R2 (>10 years; 300 m³): Reservoir is in good condition.

Reservoir B86R3 (10 years old; 200 m³): Reservoir is in good condition.

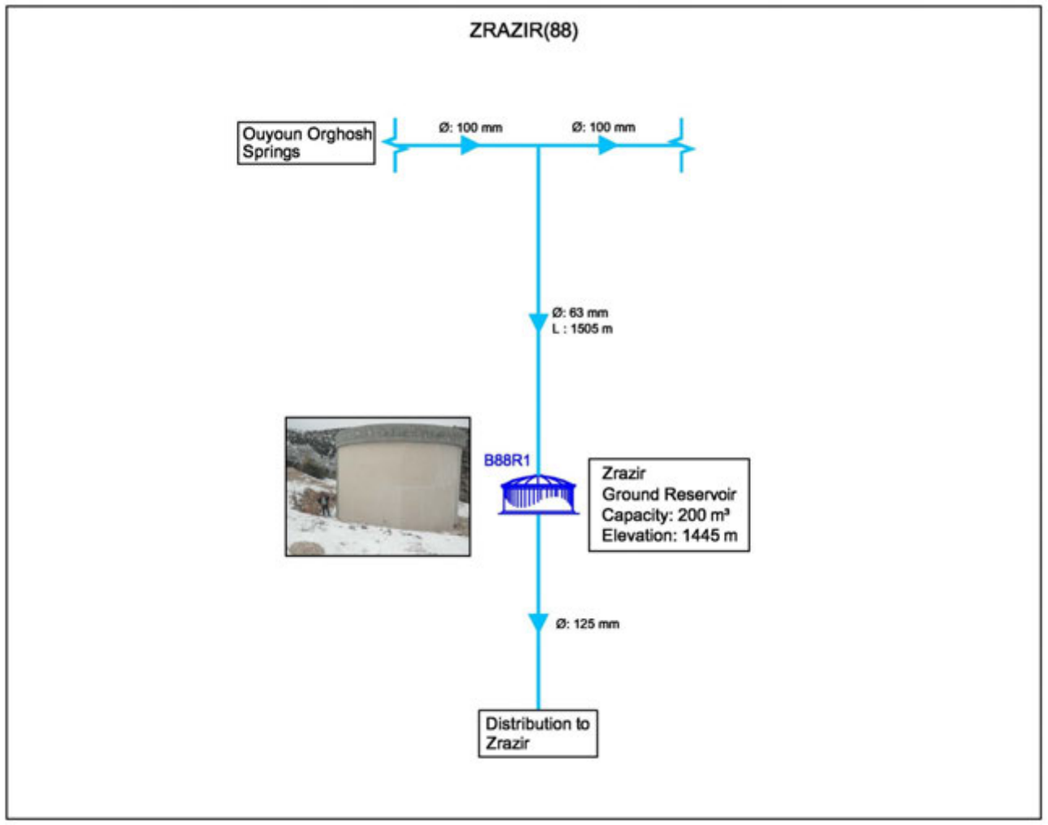
Zraieb (87)



The existing water network is in good condition and it has a length of around 4.2 km. It covers a large area of the town.

Reservoir B87R1 (>10 years; 100 m³): Reservoir is in bad condition. Yammoune water is not reaching the town. This reservoir needs rehabilitation.

Zrazir (88)



There is no available information concerning the water network of the town.

Reservoir B88R1 (200 m³): Reservoir is in good condition.

4 ZAHLE CAZA

4.1 Water networks

Table 4-1 summarizes the results of the data collection campaign carried out through the questionnaires and over the phone. Twenty four municipalities were contacted. Of those, 18 answered affirmatively regarding the existence of a water network, 1 answered negatively, and 5 did not provide any answers. However the maps for these 6 municipalities were obtained in addition to the maps for 12 out of the 18 that answered positively. The missing maps belong to the following villages: Bouarej, Fourzol, Mraijat, and Jdita (however these were all described by their respective municipalities as being very old and hence maps are probably non-existent); in addition to Niha and Terbol (the network in Terbol is controlled by the municipality which was uncooperative).

Figures 4-1 and 4-2 show that 8% of the Zahle population, representing 25% of the caza villages, is not served by any water networks (existing or planned), while 92% of the population representing 75% of the villages will be served by existing or planned networks.

Plans 4-1, 4-2 and 4-3 show the layout of the existing and planned water networks (whenever available) for the caza of Zahle as a whole, the city of Zahle and the area of east Zahle respectively.

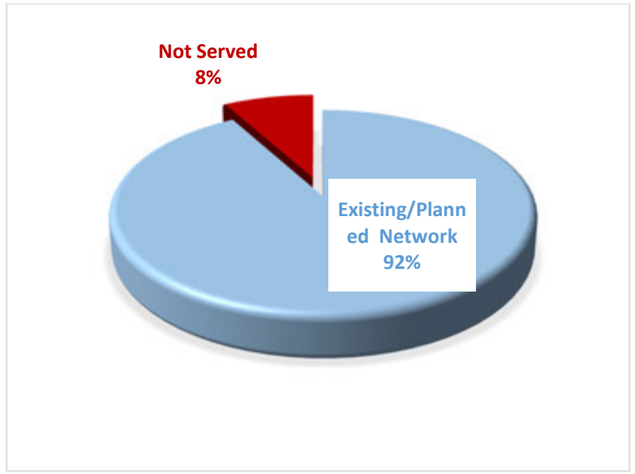


FIGURE 4-1: PERCENTAGE OF POPULATION SERVED BY WATER NETWORKS IN ZAHLE CAZA

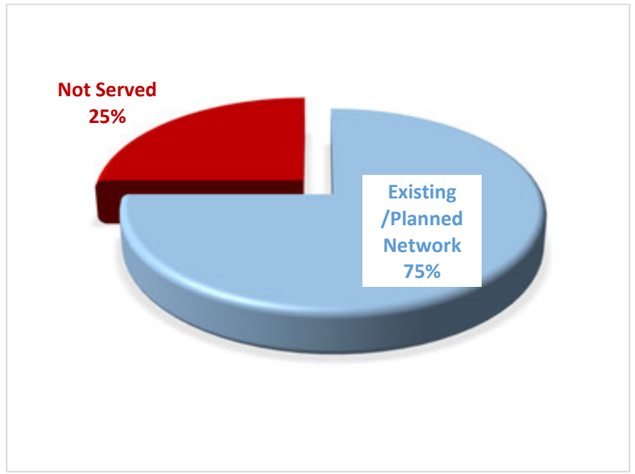
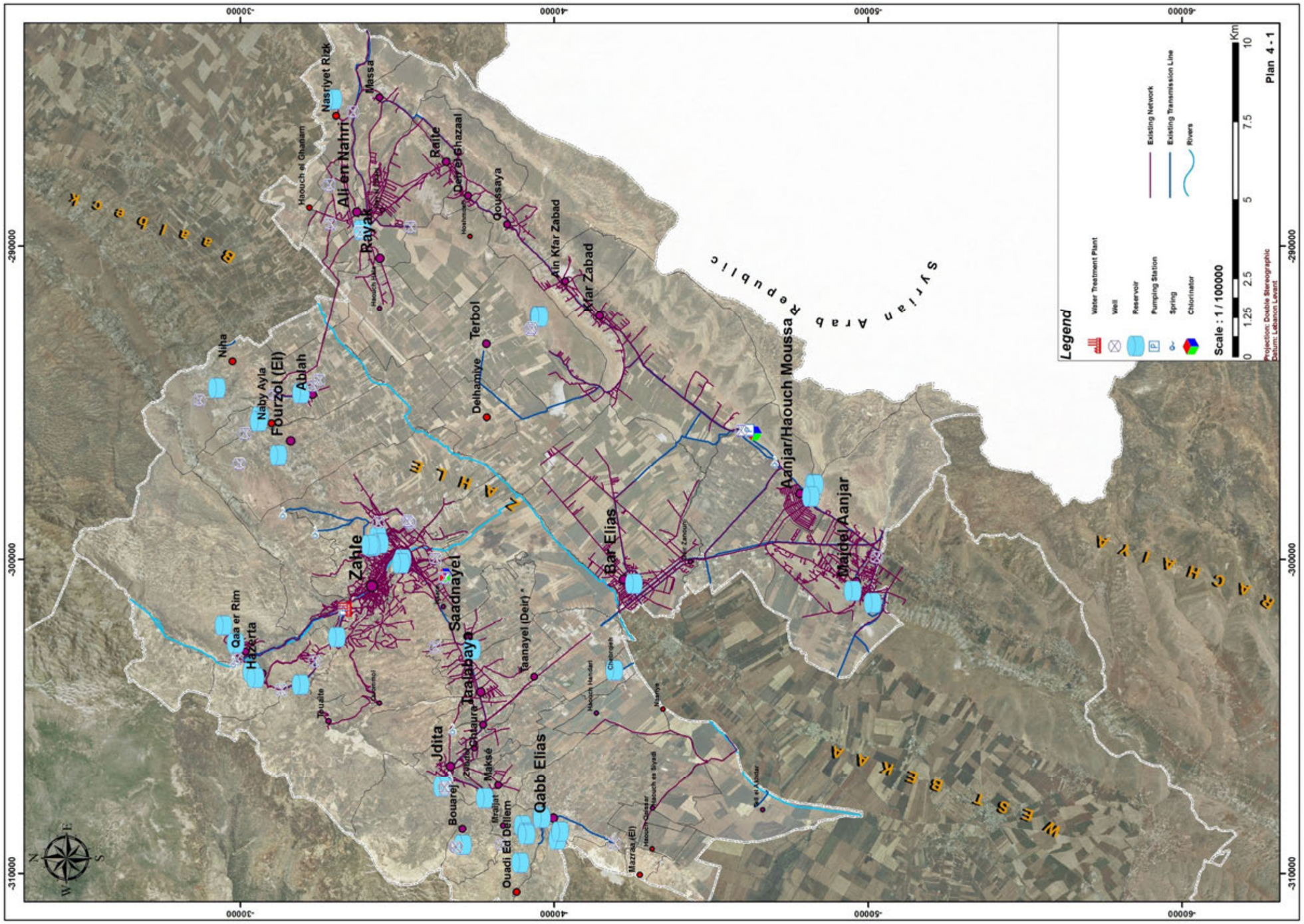


FIGURE 4-2: PERCENTAGE OF VILLAGES SERVED BY WATER NETWORKS IN ZAHLE CAZA

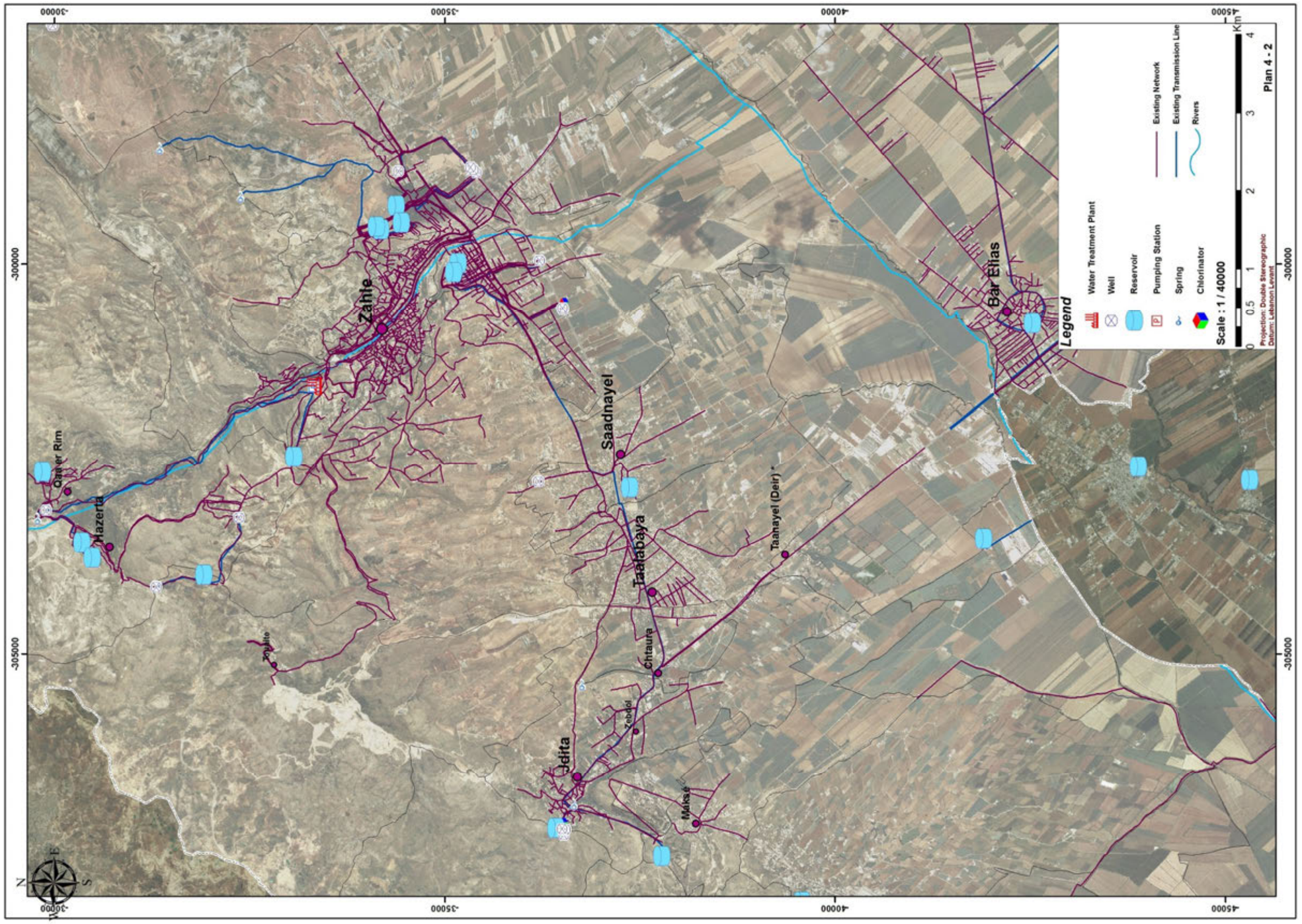
TABLE 4-1: WATER NETWORK STATUS IN CAZA OF ZAHLE

Caza		Village Name	Information From Questionnaire/Phone Interview						Response Of Municipality To Phone Request For Water Maps	Network Maps Availability Status
			Wells	Srping	Water Network	Water Source	Network Construction Date (Year)	Status Of Water Network According To Municipality		
Zahle	1	**Aanjar**	No answer	No answer	Yes	Artesian well	1993	* Network is very old (bad condition)	Municipality promised to help but did not follow through	Obtained - existing network
	2	**Ain Kfar Zabad**	No answer	No answer	Yes	Aanjar well	1950s	* Network is very old (bad condition)	Not cooperative	Obtained - existing and planned network
	3	**Barr Elias**	No answer	No answer	Yes	No answer	Very old	No answer	Not cooperative	Obtained - existing network
	4	**Bouarej**	No answer	No answer	Yes	Spring & 3 new wells	Very old	* Network is very old (bad condition)	Not available at municipality	Not obtained
	5	**Chtaura**	No answer	No answer	No answer	No answer	No answer	No answer	Not cooperative	Obtained - existing network
	6	**Deir El Ghazal**	No	Yes	Yes	No answer	No answer	* Water network is in bad condition.	Did not call - data already available	Obtained - existing and planned network
	7	**Fourzol (El)**	No answer	No answer	Yes	Fourzol well	Very old	* Network is very old (bad condition)	Promised to provide them but did not follow through	Not obtained
	8	**Hay El Fikani**	No answer	No answer	No	----	----	----	----	Obtained - planned network
	9	**Hazerta**	Yes	No	Yes	Qaa Er Rim spring & 2 wells	Very old - 60 years old	* Network doesn't cover all village * Network is in bad condition * Maximum pipe size of this network is 2 inch * New network was designed by arch, but still not installed	Sent maps of the planned design (hardcopy & softcopy)	Planned design obtained existing network not obtained
	10	**Jdita**	Yes	No	Yes	3 wells in Jdita	Very old	* Network is very old (bad condition)	Did not call - data already available	Obtained - existing network
	11	**Maallaqa**	No answer	No answer	No answer	No answer	No answer	No answer	Not cooperative	Obtained - existing network
	12	**Maksé**	No	No	Yes	Jdita well	More than 10 years	* Water network is in good condition	Told us they don't know where maps can be obtained from	Obtained - existing network
	13	**Majdel Aanjar**	No answer	No answer	Yes	No answer	Very old	* Network is very old (bad condition) * A new network was installed (funded by Kuweiti fund)	Told us to go to the Kuweiti fund	Obtained - existing network (new & old)
	14	**Massa**	No answer	No answer	No answer	No answer	No answer	No answer	Couldn't get new phone number. Available one invalid.	Obtained - existing network (main lines only) and planned network

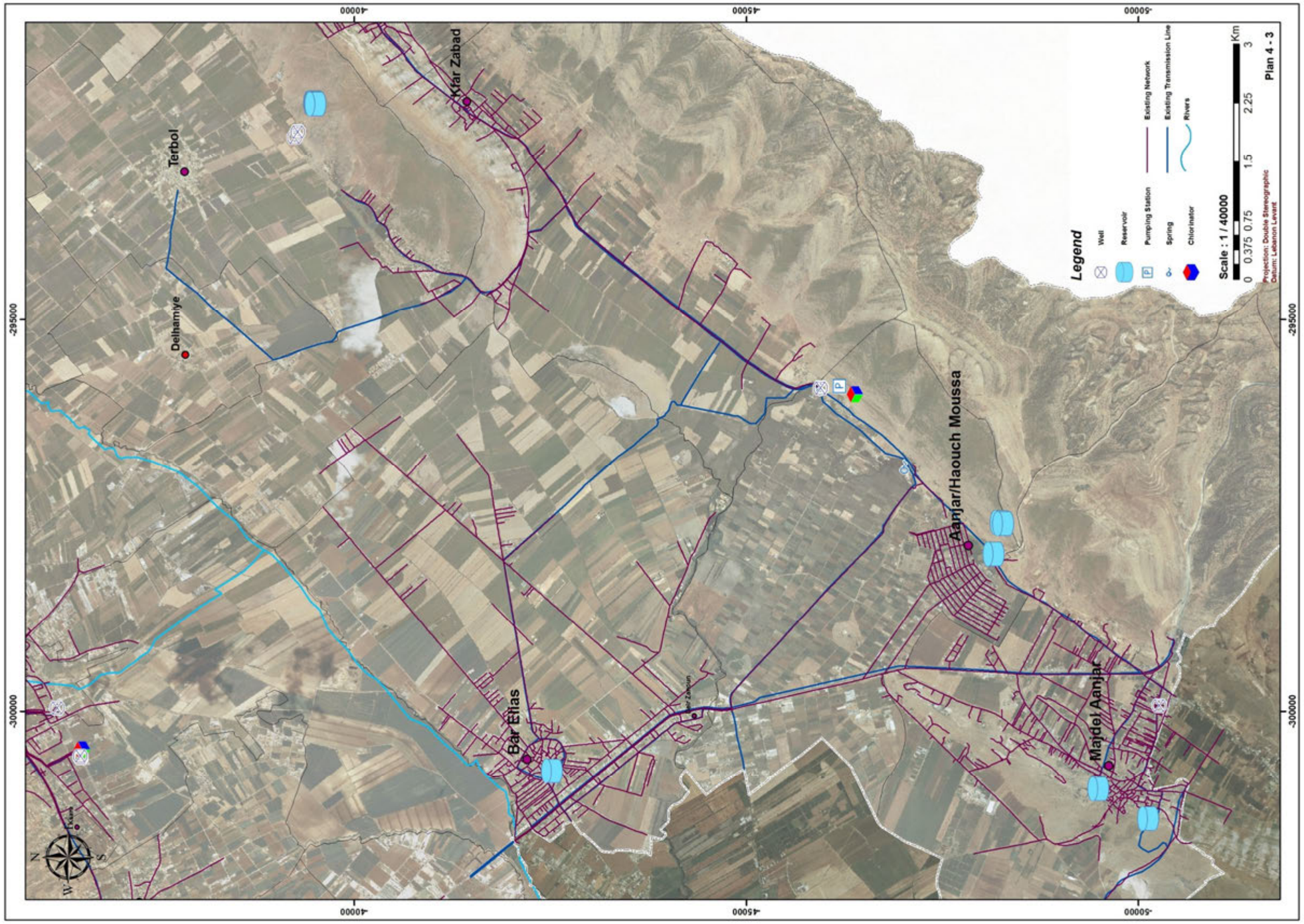
Caza		Village Name	Information From Questionnaire/Phone Interview						Response Of Municipality To Phone Request For Water Maps	Network Maps Availability Status
			Wells	Srping	Water Network	Water Source	Network Construction Date (Year)	Status Of Water Network According To Municipality		
	15	**Mraijat (El)**	No answer	No answer	Yes	Mraijat well	Very old	* Network is very old (bad condition) * New pipes were installed 5 years ago between well and reservoir	Municipality promised to help but did not follow through	Not obtained
	16	**Niha**	No answer	No answer	Yes	No answer	No answer	No answer	told us to contact CDR	Not obtained
	17	**Qaa Er Rim**	No answer	No answer	Yes	No answer	1990s	* Network is very old (bad condition)	Not cooperative	Obtained - existing network
	18	**Qabb Elias / Ouadi Ed Dellem**	Yes	Yes	Yes	No answer	Old	* Network covers 75% of the town. * Pipes sizes range between 1.5" and 8". * Network length is around 50 km. * the eastern and industrial areas of the town don't have a water network	Did not call - data already available	Obtained - existing network (transmission lines only)
	19	**Qoussaya**	No	No	Yes	No answer	1960	* Network is very old (bad condition)	Did not call - data already available	Obtained - existing and planned network
	20	**Raite**	No	No	Yes	No answer	1960	* Network is very old (bad condition) * Not connected to all houses	Did not call - data already available	Obtained - existing and planned network
	21	**Saadnayel**	No answer	No answer	Yes	Jdita well	1945	* Network is very old (bad condition)	Municipality promised to help but did not follow through	Not obtained
	22	**Taalabaya - Jalala**	No answer	No answer	No answer	No answer	No answer	No answer	Refused to answer any question	Obtained - existing network
	23	**Taanayel (Deir)**	No answer	No answer	No answer	No answer	No answer	No answer	Not cooperative	Obtained - existing network (only main line)
	24	**Terbol**	No answer	No answer	Yes	Private well	1990s	* Private network controlled by the municipality	Not cooperative	Not obtained



PLAN 4-1: WATER SYSTEMS FOR CAZA OF ZAHLE



PLAN 4-2: WATER SYSTEMS FOR CAZA OF ZAHLE – ZAHLE CITY



PLAN 4-3: WATER SYSTEMS FOR CAZA OF ZAHLE – EAST

4.2 Zahle Water Treatment Plant (ZWTP)

4.2.1 Plant Background

The Zahle water treatment plant (ZWTP) is located in Rassieh Street in Zahle and receives water from the Qaa Er Rim springs and the Zoueitini Spring. Water is treated and chlorinated before it is distributed to customers. The maximum capacity of this plant is 12,000 m³/day and is intended to serve ultimately 60,000 persons at a rate of 200 liters/person/day in the year 2015. This plant serves some areas and districts in Zahle city such as: Ouadi El Aarayech, Mar Elias, Al-Rassieh, the industrial zone, Medan, Medan Ali, Haouch Al-Zaraan, Haret Annassani, And Barbara by gravity, while a pumping station conveys the water to the upper areas of Zahle (namely Dhour and el Karme). It was constructed in 1967 and rehabilitated in 1999. It is connected to the spring via a 3 km long network of cast iron 20 cm in diameter and discharges into a 15 km long distribution network consisting of pipes varying in diameter between 15 and 30 cm. The Bekaa water establishment is in charge of operating and maintaining this plant which is equipped with a laboratory where water quality tests can be performed. The plant is managed by a manager and 5 assistants, and the laboratory is operated by 4 lab technicians.

4.2.2 Treatment Process

The inflowing water is first collected in a primary balance tank. It then flows through a distributing manhole located 2 m below the tank, is divided in two equal flows, and enters two decanters from the bottom. The flow is discharged from the top of the decanters through multi v-notch weirs into 8 channels that convey it to the top of the three sand filters. The water percolates to the bottom of the sand bed to reach the chlorination zone. The sand filters are backwashed immediately when the water flows on top of them. After the sand beds, the water is chlorinated using pressured chlorine gas and then sent to the distribution network.

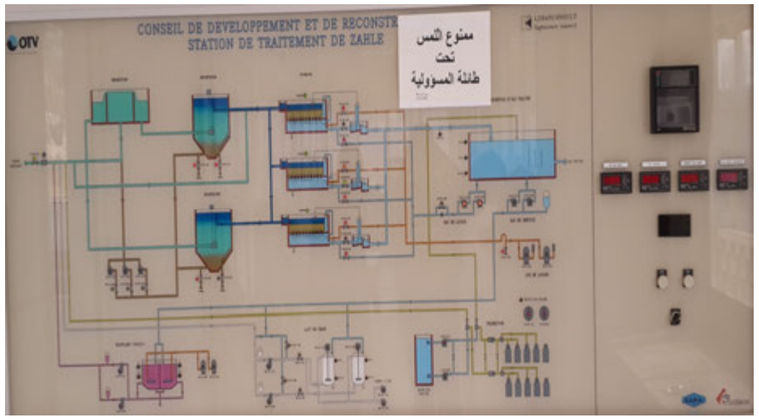


PHOTO 4-1: ZAHLE WTP - PLANT SCHEMATICS

PHOTO 4-2: ZAHLE WTP - BALANCE TANK

PHOTO 4-3: ZAHLE WTP - MANHOLE

PHOTO 4-4: ZAHLE WTP – DECANTER

PHOTO 4-5: ZAHLE WTP - SAND FILTERS

4.2.3 (ZPWPP) Assessment:

The plant is operating properly. At the time of the visit, it was operating at 70% of its maximum capacity, receiving 350 m^3/hr instead of 500m^3/hr due to the lowered water table. The plant is expected to operate at 100% of its maximum capacity during winter. The availability of a backup generator (230 kva) allows the operating team to operate the plant 24/24 hours.

The following measures are recommended to improve the plant:

1- Civil works maintenance is required for the balance tank, the two decanters, the stairs and the fences.
2- A solution to the freezing problem of the chlorination unit during winter is needed. It is recommended to replace the chlorine gas with hypochlorite batched at the site to avoid the risks of freezing and explosion of the chlorine bottles.
3- Sludge should be removed from the bottom of the decanters
4- An emergency plan must be devised in order to minimize the potential impacts of any accidental spillage of the chlorine gas.

4.3 Zahle Water Facilities

In the caza of Zahle the layout of the water facilities, along with their assessment are included for 30 localities. The other 24 localities do not have any BWE facilities. Some of these villages are supplied with water from another village (in which case this will be shown on the schematics of that village), while the others rely on private wells and/or non-serviced sources or on privately acquired water. As can be seen on some of the layouts, some facilities are not connected to the system because no information could be obtained about their position relative to the other facilities.

In the caza of Zahle, there are reservoirs of all sizes: 30% have a capacity of less than a 100 m^3, 9 % have a capacity larger than 2000 m^3, and 23 % have a capacity between 100 and 200 m^3 (figure 4-3). As shown in figure 4-4, 14 % only of all the reservoirs (ground reservoirs and elevated tanks) were found to be in good condition, 11% need minor improvements and/or maintenance, while 50% need major rehabilitation or reconstruction. For about 25 % of the reservoirs, not enough information to conduct an assessment could be gathered. This percentage is high due to the fact that for the caza of Zahle a number of the facilities listed in this study were not included in the BWE original database and related documentation. They were rather added as of late following oral communications with BWE staff and some new informal plans that were uncovered. The wells are divided in two categories, namely functional and non-functional. However, a functional well may need various types of improvements to become efficient as it could be providing water intermittently or insufficiently. Overall, 27 % of the Zahle wells are currently non-functional (figure 4-5), while 21% of them lack the information needed for proper classification due to the same reason listed above.

In addition to the system layouts per village, the system layout of the Chamsine spring is included. It shows the connections between the spring and the reservoirs receiving the water and distributing it to the villages. Some of these villages are located in the cazas of West Bekaa and Rachaiya. Some of the reservoirs shown on these layouts might actually be receiving water from other sources as well such as another reservoir, a well, or a local spring. In this case, the information would be depicted in the specific layout of the village where the reservoir is located. On the other hand, for some other reservoirs included on these layouts, no information could be obtained about their locations or characteristics and hence they are not included in the specific schematic of the village where they are located. These reservoirs are not coded.

According to an oral communication with the BWE, the Chamsine spring water is not currently reaching past the reservoir in Hammara due to leakage problems and some broken pipes. Instead the Sultan Yacoub regional reservoir (system layout included in section 5.2) which receives water from the Loussi well is distributing water by gravity using the same network to some of the villages located downstream. Most of the remaining villages that are not currently receiving water from the Chamsine spring will in the future receive water from the Ain El Zarqa spring system (executed but not functional yet) which is included in section 5.2 of this report with the West Bekaa water facilities. The two large reservoirs in Anjar are new. They supply water to seven localities namely Anjar, Rawda, El Marj, Barr Elias, Khiara, and Haouch El Harime, And Istabl. However, the layout of the network connecting these reservoirs to these villages is not available.

Table 4-2 lists the 13 springs identified to date in the caza of Zahle as being used as a water source. The minimum, maximum, and average flows for these springs are listed along with the years for which recordings are available and the entity from which the data was collected. In some instances, these recordings consist of daily measurements, for others there are monthly measurements, while for some there are only sporadic measurements. For 6 of the springs, no information whatsoever is available to date regarding the water flow.

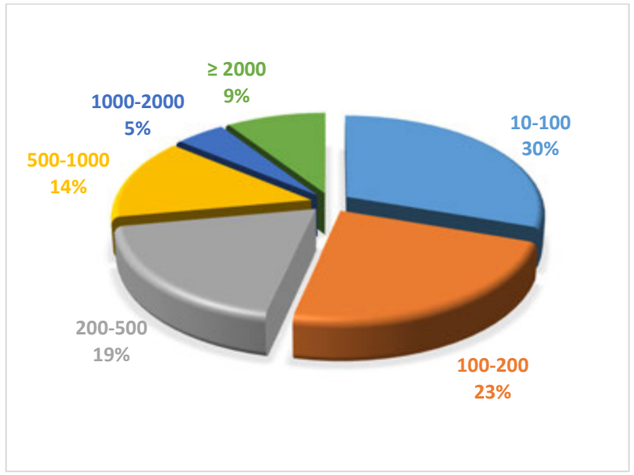


FIGURE 4-3: RESERVOIRS CAPACITY IN ZAHLE CAZA (IN M^3)

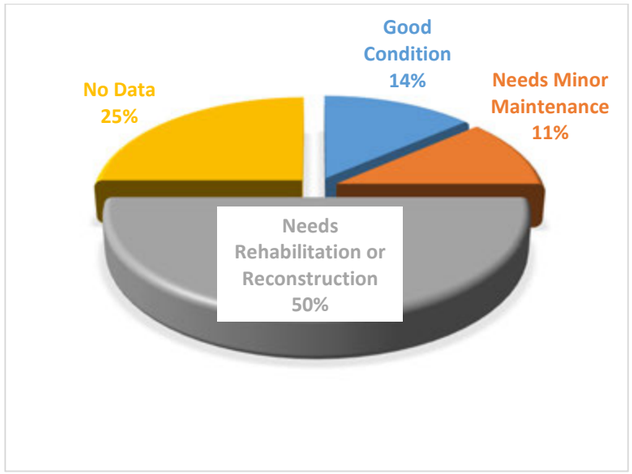


FIGURE 4-4: RESERVOIRS CONDITION IN ZAHLE CAZA

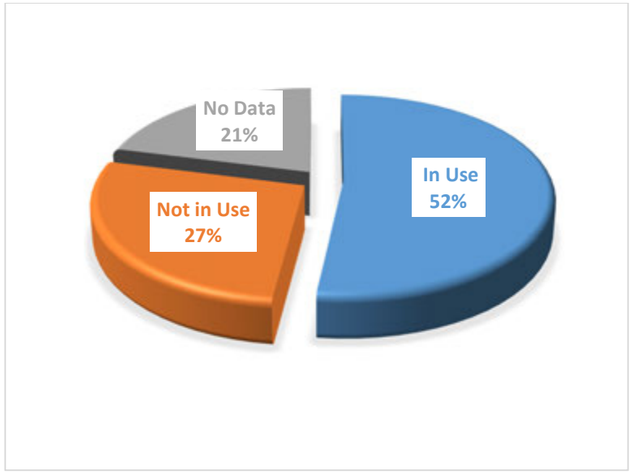


FIGURE 4-5: WELLS STATUS IN ZAHLE CAZA

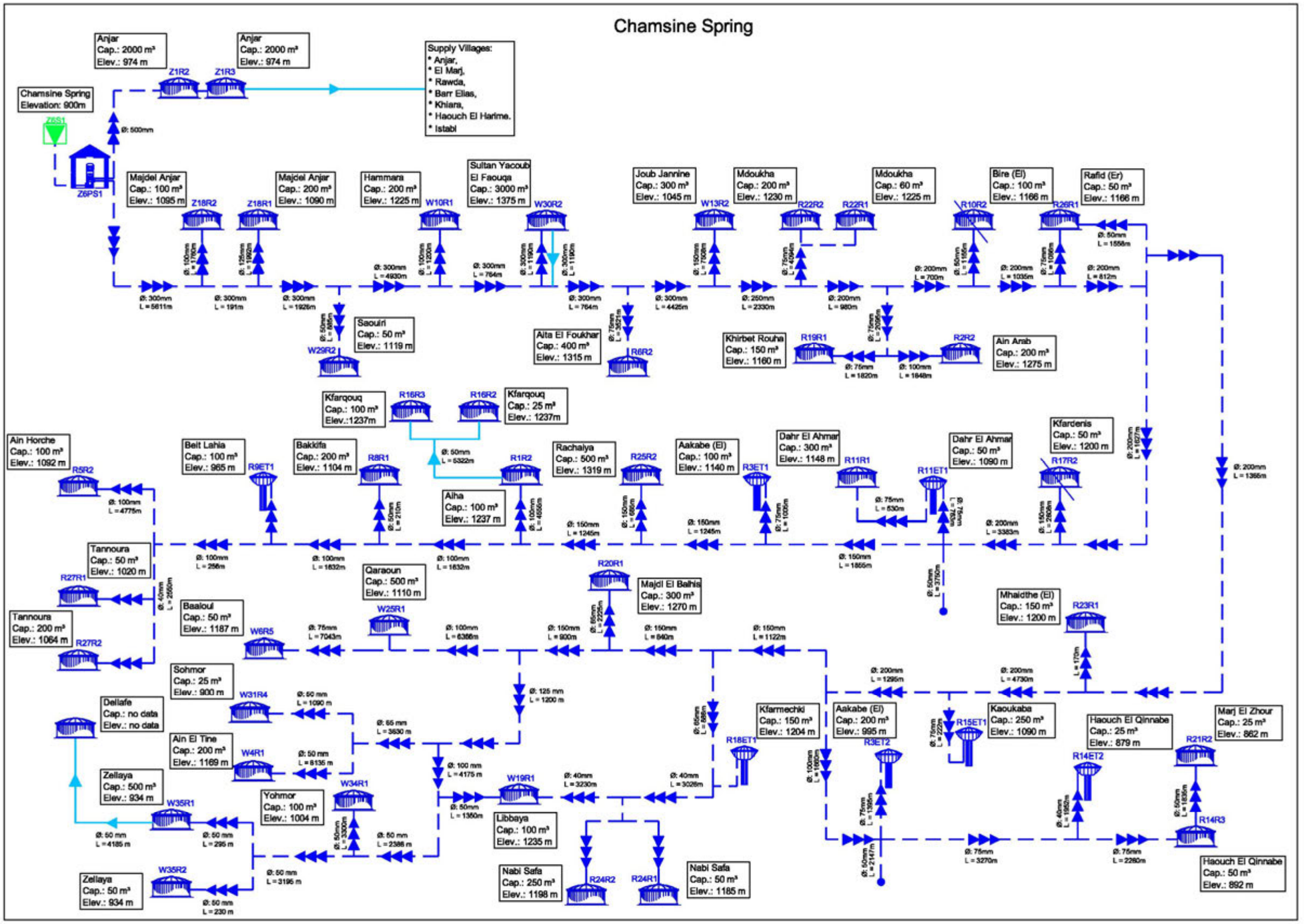
TABLE 4-2: SPRINGS IN ZAHLE CAZA

Casa	Spring name	Village	Code	Elevation	Min. Flow (l/s)	Max. Flow (l/s)	Avg. Flow (l/s)	Comments
Zahle	Ain El Chouaghir		Z20S2	1214m				Exact location unknown
	Ain El Hashas		Z5S1					Exact location unknown
	Ain Ez Zarke		Z20S1	1510 m				Exact location unknown
	Al Ammoury		Z27S1	1088m				Exact location unknown
	Al Habis		Z8S1	1107m				Exact location unknown
	Berdaouni (Qaa El Rim)	Qaa El Rim	Z10S1	1251m			337	BTD (29 Dec. 2011)
					40	5,610	1,258	LRA (2009-2011)
	Bhoucha (Karak Nouh)	Karak Nouh	Z17S2	1173m			4	BTD (Sep. 2009)
	Bsouja (Karak Nouh)	Karak Nouh	Z17S1	1157m				Dry in July
	Chamsine	Zahle	Z6S1	900m	0	1,826	280	LRA (1967-1974, 2001-2011)
	Halabiya		Z29S2	1123m			27	BTD (29 Dec. 2011) - used for irrigation- exact location unknown
	Qabb Elias (Ouadi El Delm)	Qabb Elias	Z25S1	987m	0	26,737	651	LRA (1967-1974,1998-2011)
	Zahle Old Spring		Z29S1	1242m			90	Exact location unknown, BTD (1 Sep. 2009)
	Zoueitini		Z29S3	1113m			3.3	Exact location unknown, BTD (29 Dec. 2011)

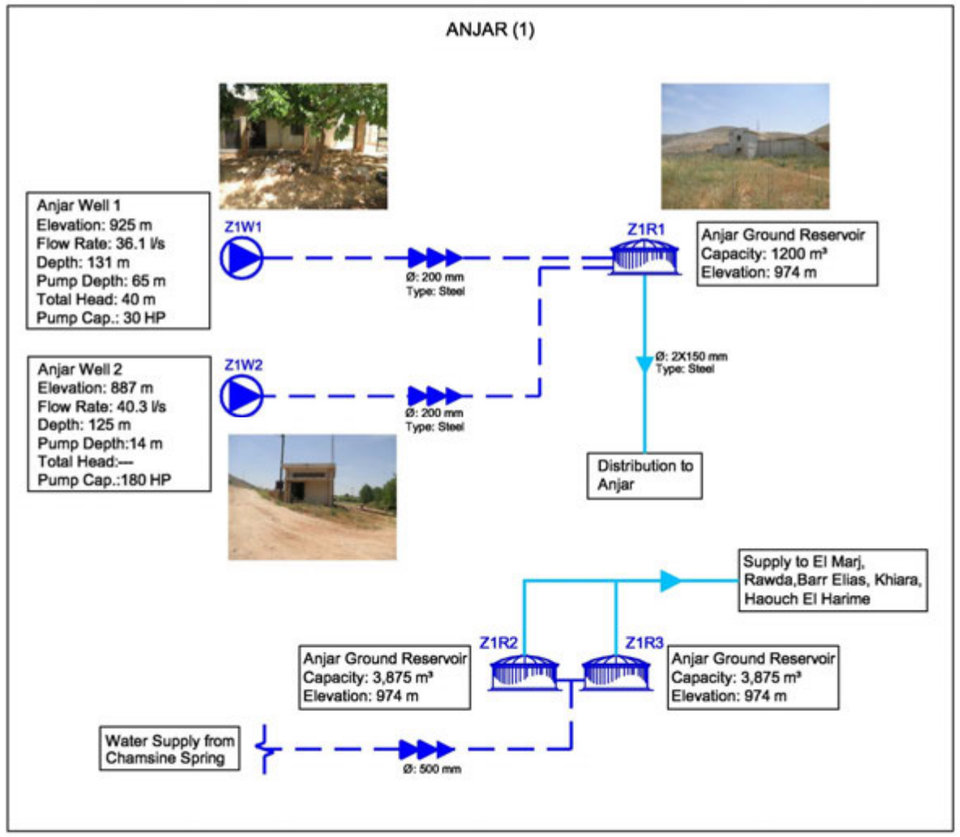
Legend:


LEGEND:
Gravity Pipe - Existing
Pressure Pipe - Existing
Pump Station - Existing
W.T.P
WTP
Well - Existing
Spring
Elevated Tank - Existing
Reservoir - Existing
CL
Chlorinator

Chamsine Spring:



Anjar (1)



The existing water network is in very good condition and it has a length of around 27 km. It covers a large area of the town.

Well Z1W1 (15 years old): No information available.

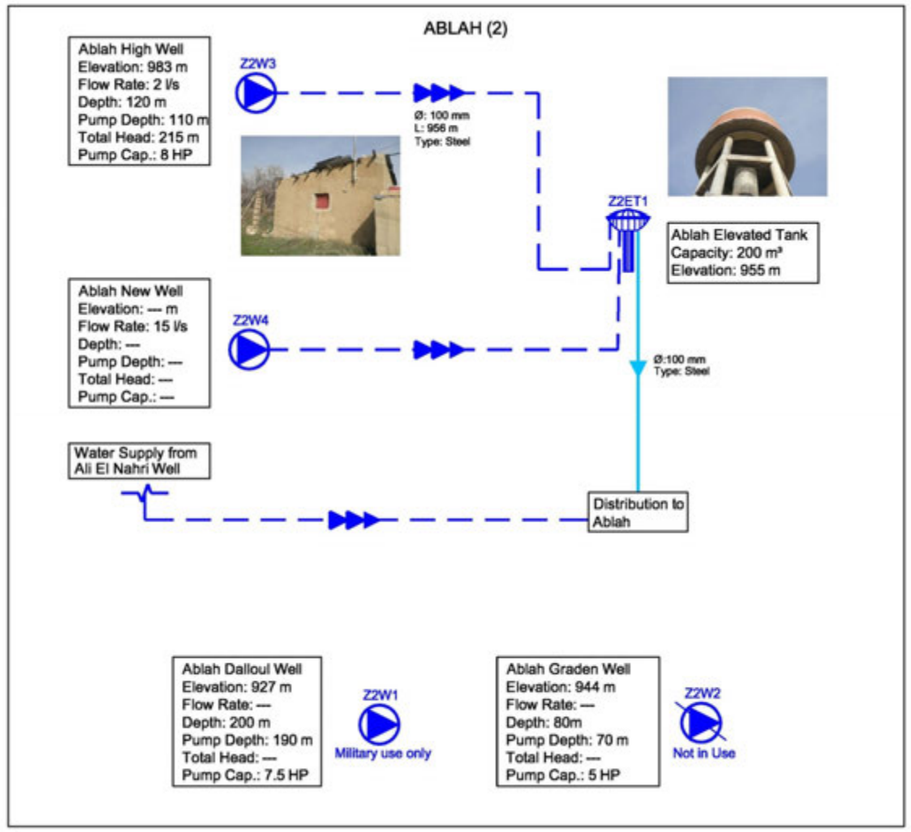
Well Z1W2 (75 years old): No information available.

Reservoir Z1R1 (>65 years; 1200 m³): Reservoir is old. Its pipes are rusted. This reservoir needs structural and architectural rehabilitations.

Reservoir Z1R2 (3875 m³): Reservoir is new and it is in good condition.

Reservoir z1R3 (3875 m³): Reservoir is new and it is in good condition.

Ablah (2)



The existing water network is in medium condition and it has a length of around 9 km. It covers a part of the town.

Well Z2W1: Well is used only for military purposes. There is no direct water outlet.

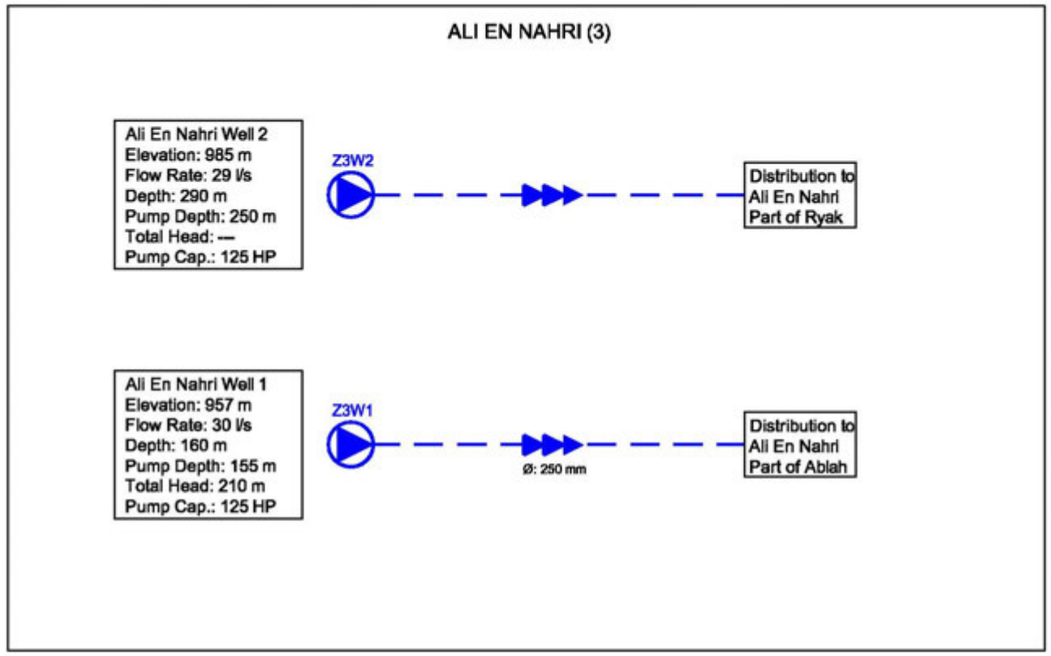
Well Z2W2: Well is not in use.

Well Z2W3 (20 years old): Well is in bad condition and it suffers from a shortage of electric power. It was constructed 10 years ago.

Well Z2W4: Well is new and it is in good condition.

Elevated tank Z2ET1 (>15 years; 200 m³): It was constructed in year 1998. It is not in bad condition but it needs structural rehabilitation.

Ali En Nahri (3)

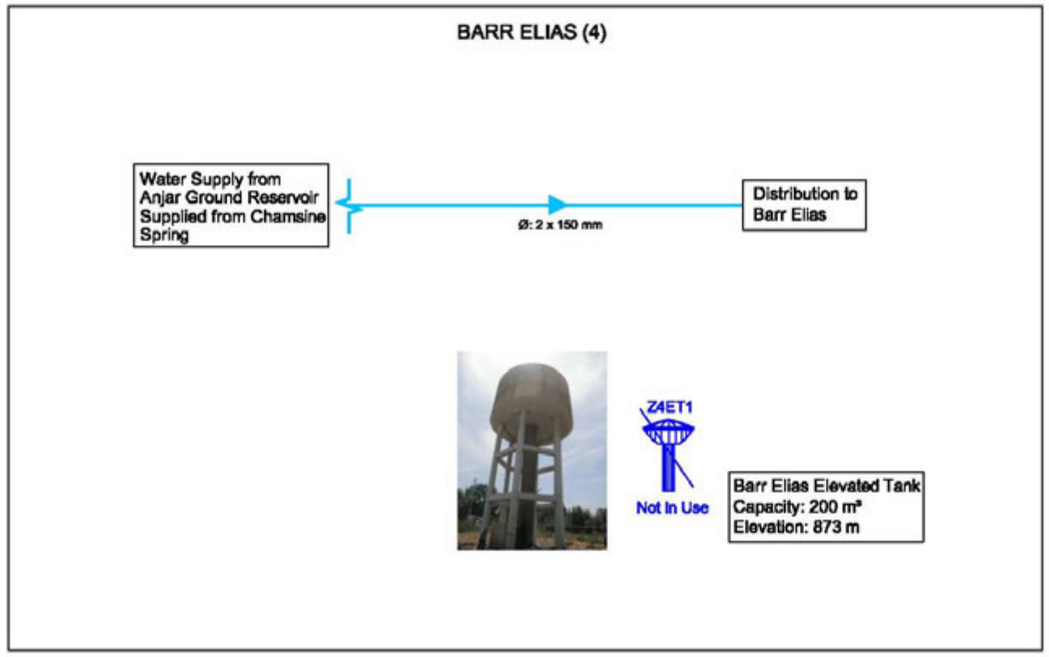


The existing water network is in medium condition and it has a length of around 16 km. It covers a large area of the town.

Well Z3W1 (>15 years): Well is very old but lately it was rehabilitated. It is not equipped to take electricity from the power point. Power will be supplied to the well by a private generator.

Well Z3W2 (10 years old): Well is in good condition. It was constructed in year 2007. A room contains two reservoirs 2 m^3 each. Also there is a very old reservoir with a volume of 10 m^3 but it is not used.

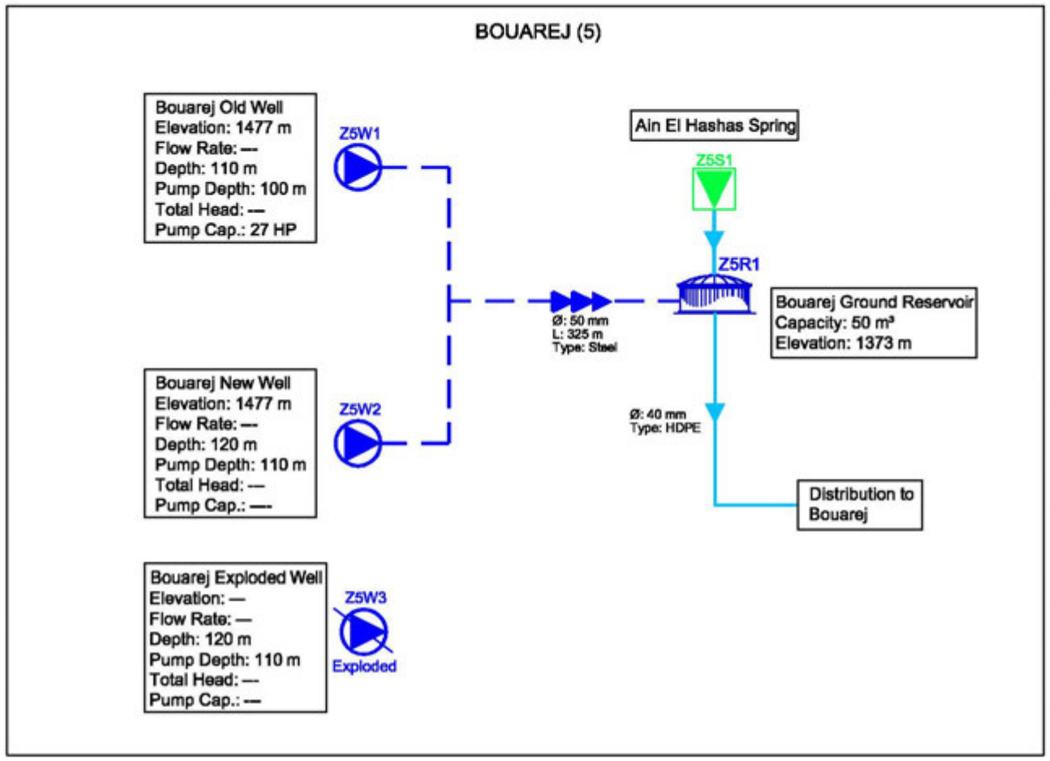
Barr Elias (4)



The existing water network is in very good condition and it has a length of around 82 km. It covers a large area of the town

Elevated tank Z4ET1 (200 m^3): Elevated tank is not in use.

Bouarej (5)



The existing water network is in bad condition and it has a length of around 8 km. It covers a large area of the town.

Well Z5W1 (20 years old): No information available.

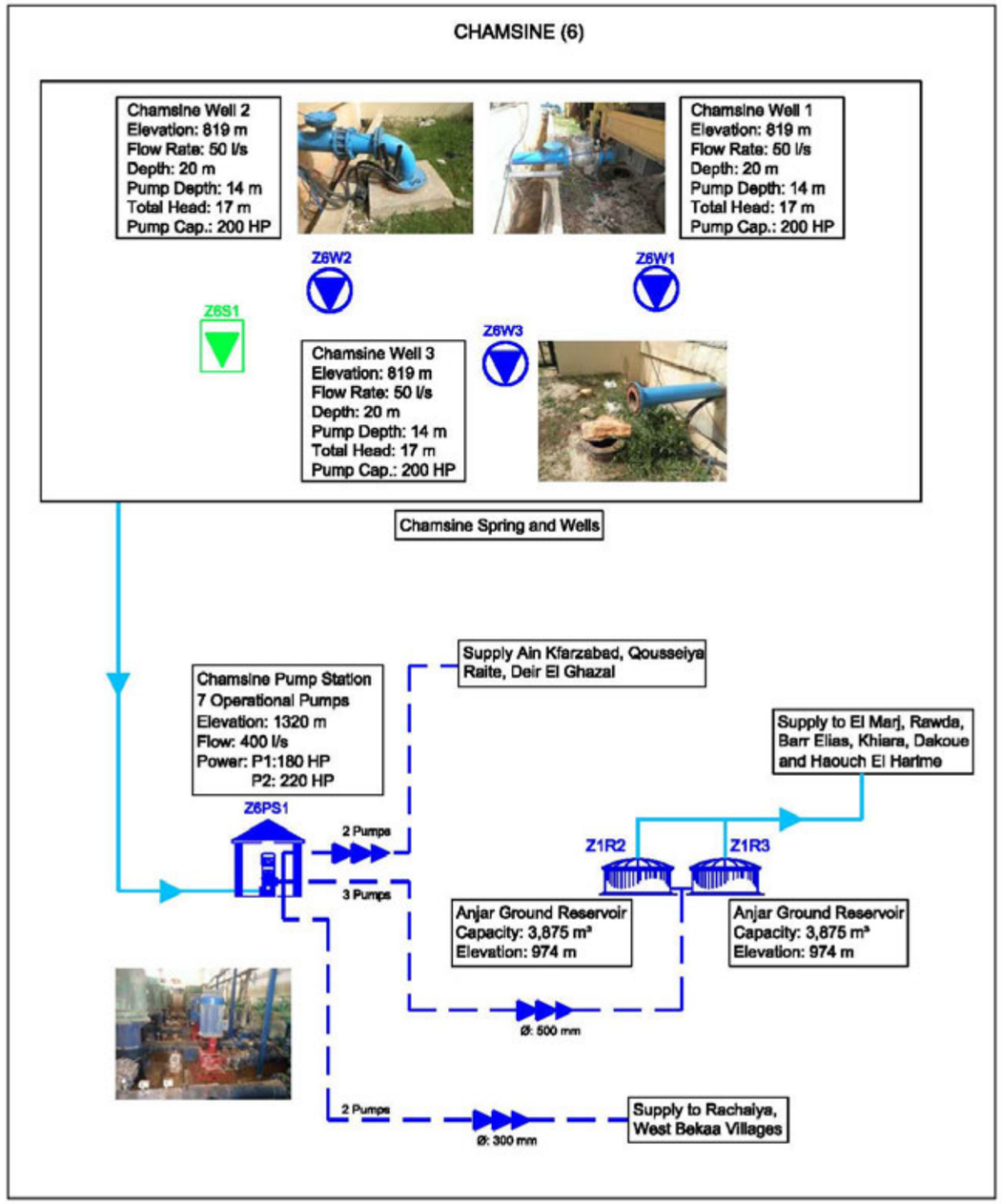
Well Z5W2 (5 years old): No information available.

Well Z5W3 (>20 years): Well is not in use anymore.

Spring Z5S1: No information available.

Reservoir Z5R1 (50 m³): No information available.

Chamsine (6)

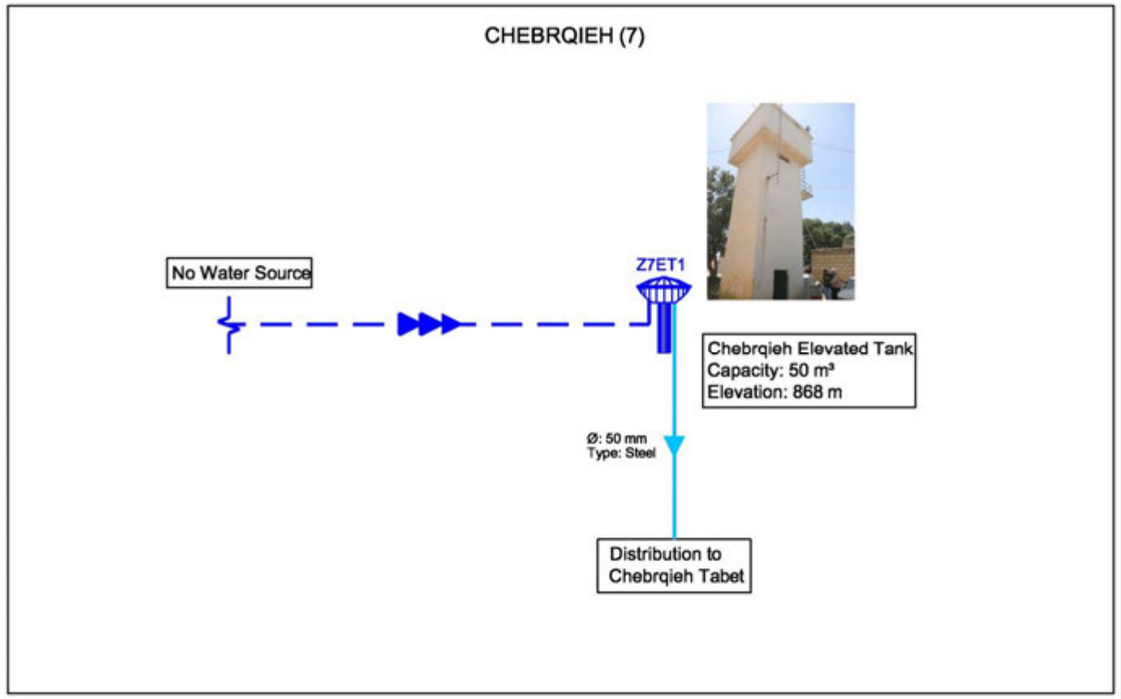


Wells Z6W1 (<5 years) & Z6W2 (<5 years) & Z6W3 (<5 years): Wells are in good condition.

Spring Z6S1: The estimated safety yield for this spring is about 214 l/s.

Pump station Z6PS1: Pump station is old but it is in good condition.

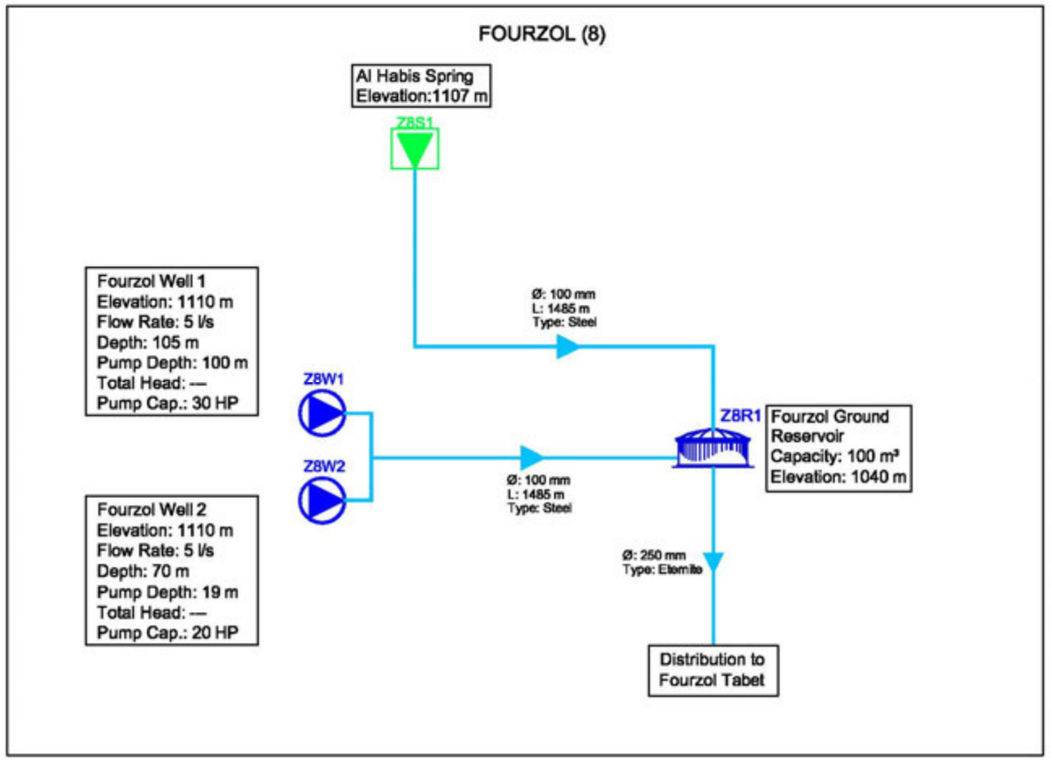
Chebrqieh (7)



The existing water network is very old (more than 30 years) and it is in bad condition. Most areas of this village are industrial. There is a problem regarding water supply between Chebrqieh and surrounding villages.

Elevated tank Z7ET1 (>60 years; 50 m3): Elevated tank is very old and it is not in use because no water source exists.

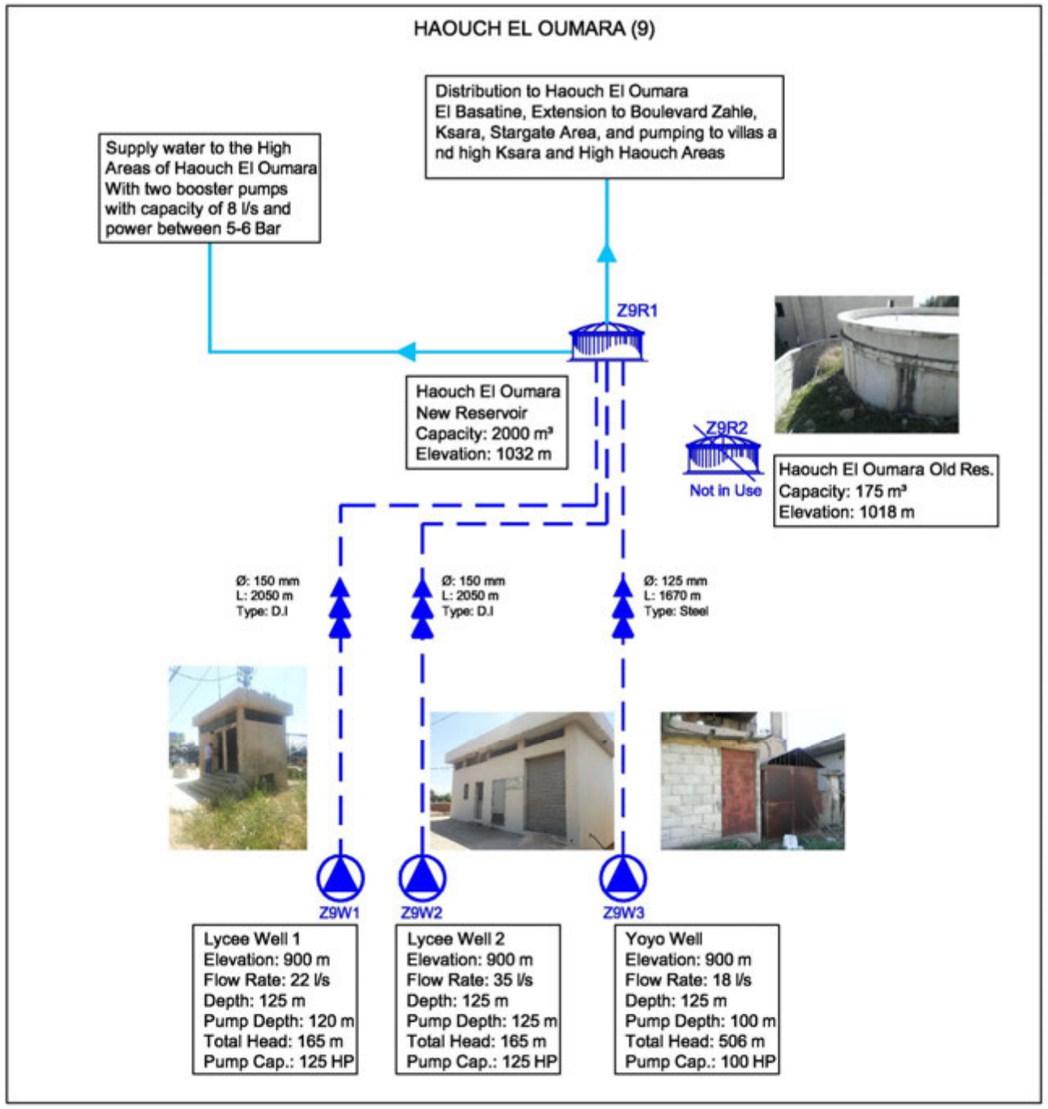
Fourzol (8)



The existing water network is in bad condition and it has a length of around 21 km. It covers a large area of the town.

Well Z8W1 (>45 years), Well Z8W2 (>45 years), Spring Z8S1, Reservoir Z8R1: no information available.

Haouch El Oumara (9)



A new network was installed and it is in excellent condition. It covers a large area of Haouch el Oumara

Well Z9W1 (15 years old): Well is not in bad condition but it suffers from a shortage of electric power. It was constructed 30 years ago.

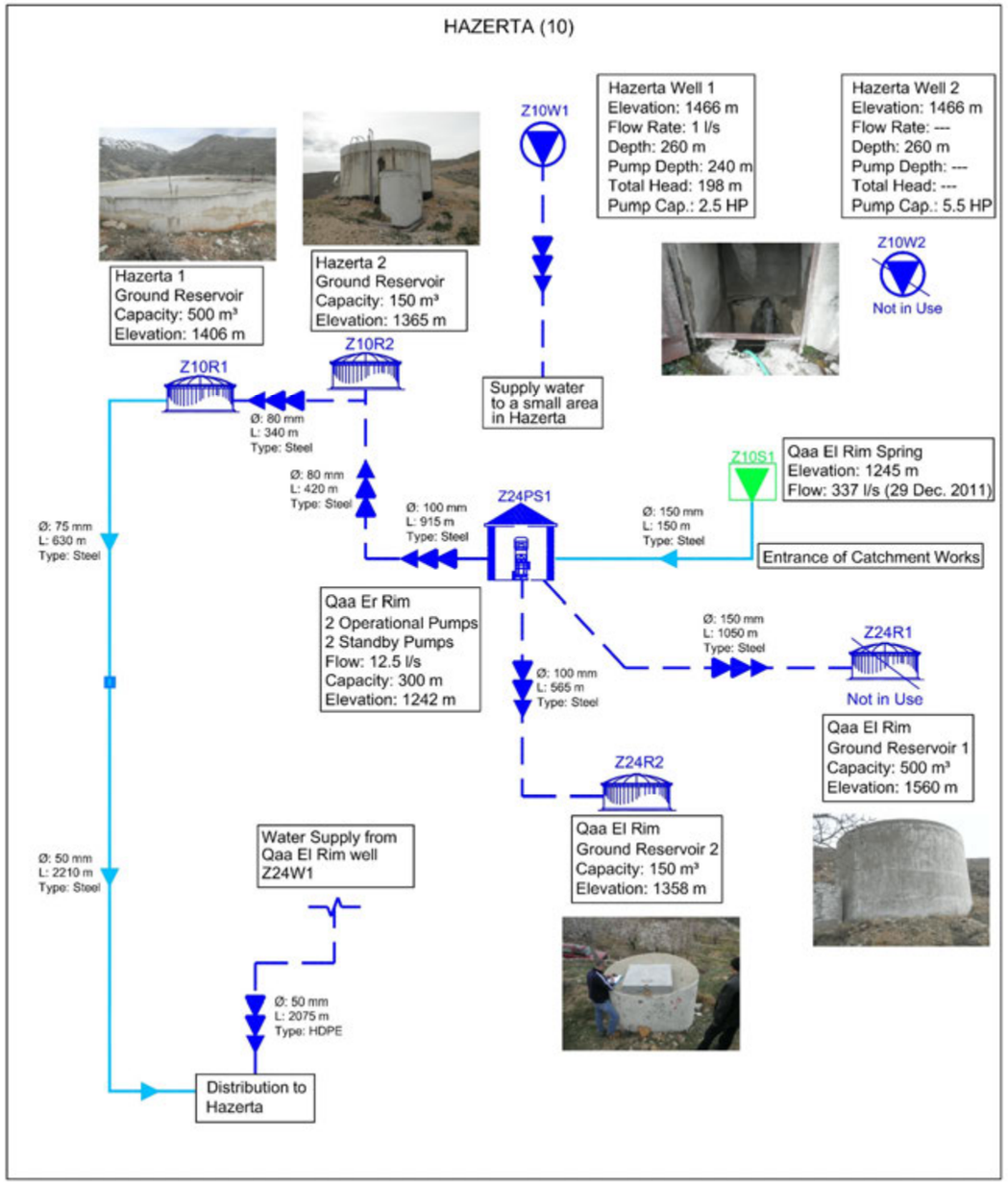
Well Z9W2: Well is not in bad condition but it suffers from a shortage of electric power. It was constructed 10 years ago.

Well Z9W3 (>15 years): Well is under rehabilitation but it suffers from a shortage of electric power. There is a private generator that supplies power only for the BWE offices located near the well station. Also there is a chlorination system but it is not functioning. This well was constructed 20 years ago.

Reservoir Z9R1 (>10 years; 2000 m³): *Reservoir* is not in very bad condition, but it needs rehabilitation. A fence must be constructed to protect the facility.

Reservoir Z9R2 (175 m³): It is in very good condition; however it needs some minor maintenance (changing some valves, pipes…). This reservoir is not in use anymore.

Hazerta (10)



The existing water network is in bad condition and it has a length of around 18 km. It covers a large area of the town.

Well Z10W1 (>5 years): Well is in acceptable condition but it suffers from a shortage of electric power. It was constructed 10 years ago.

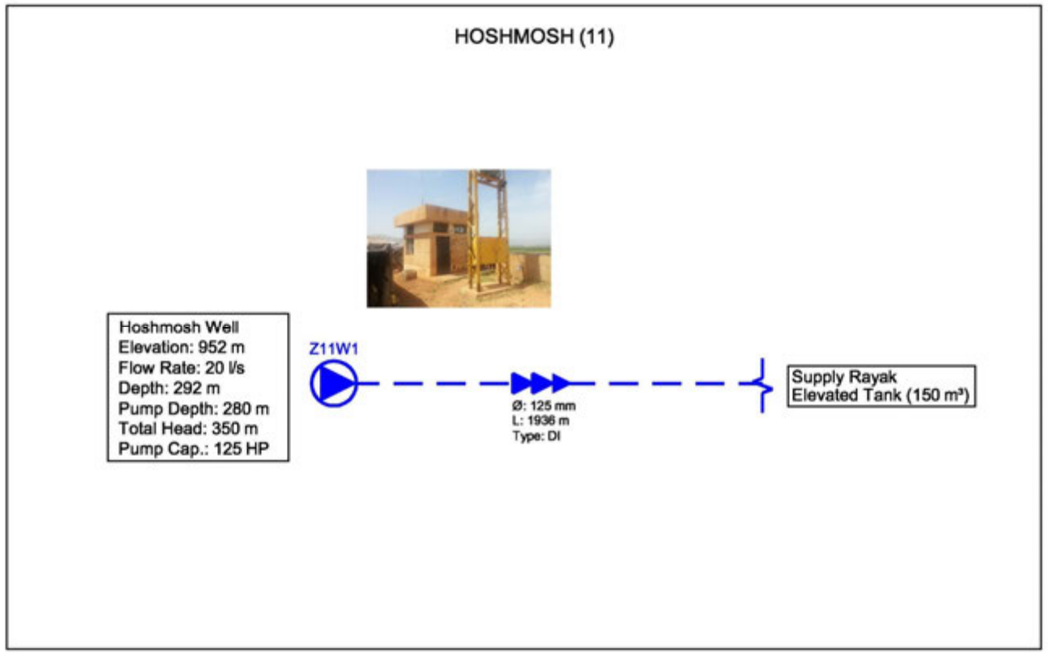
Well Z10W2 (>5 years): Well is not in use.

Spring Z10S1: Its buildings and fences are partially destroyed. No more available information.

Reservoir Z10R1 (>25 years; 500 m³): Reservoir is in good condition. Its valves need minor rehabilitations. This reservoir is not in use.

Reservoir Z10R2 (>40 years; 150 m³): Reservoir is old. Valve chamber of this reservoir is not accessible. It is subjected to leakage. It needs esthetical rehabilitation and some maintenance.

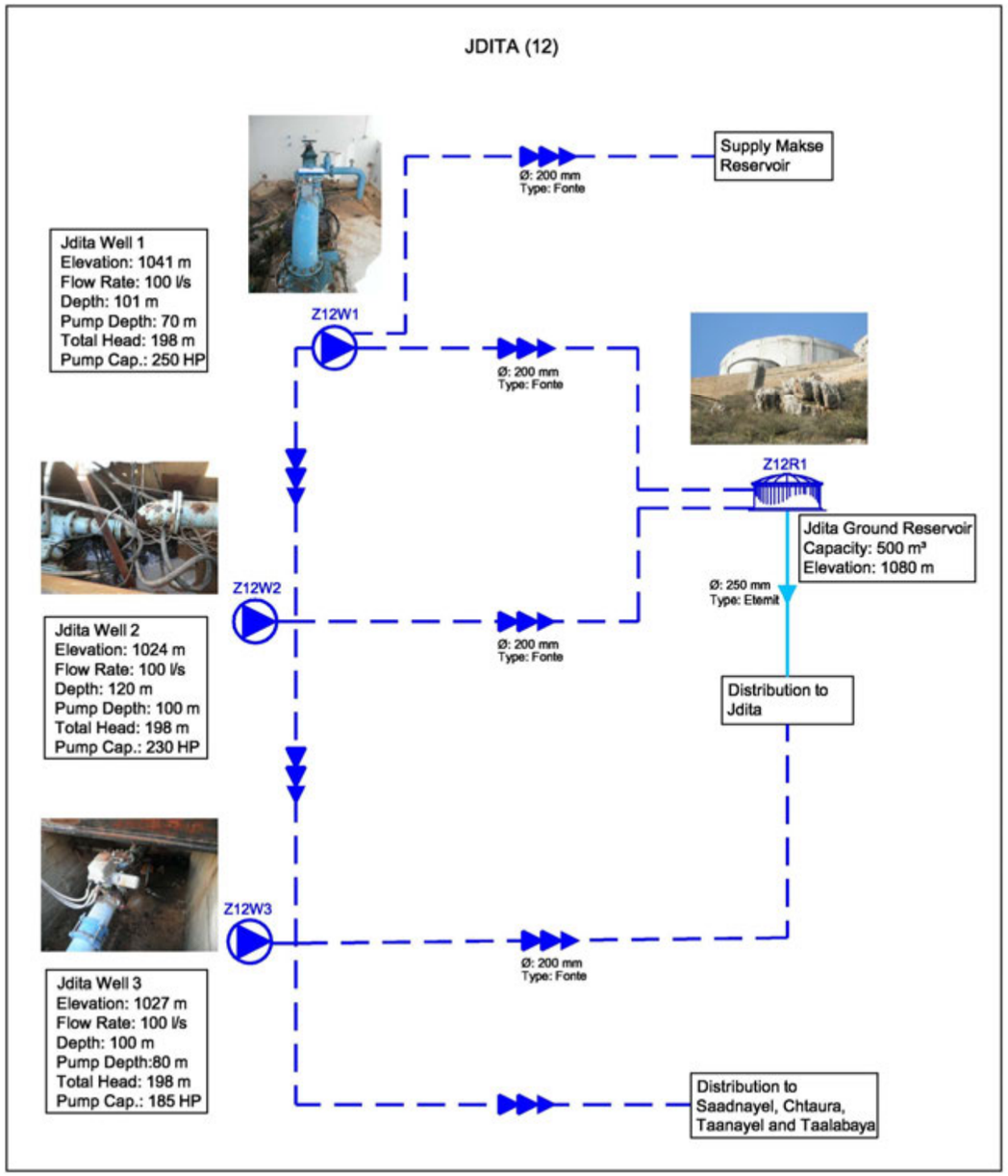
Hoshmosh (11)



There is no water existing network in this town. Water is transmitted from Hoshmosh well to Rayak elevated tank.

Well Z11W1: This well was constructed in year 2003. It is in good condition but it suffers from a shortage of electric power; however, its chamber needs some minor maintenance.

Jdita (12)



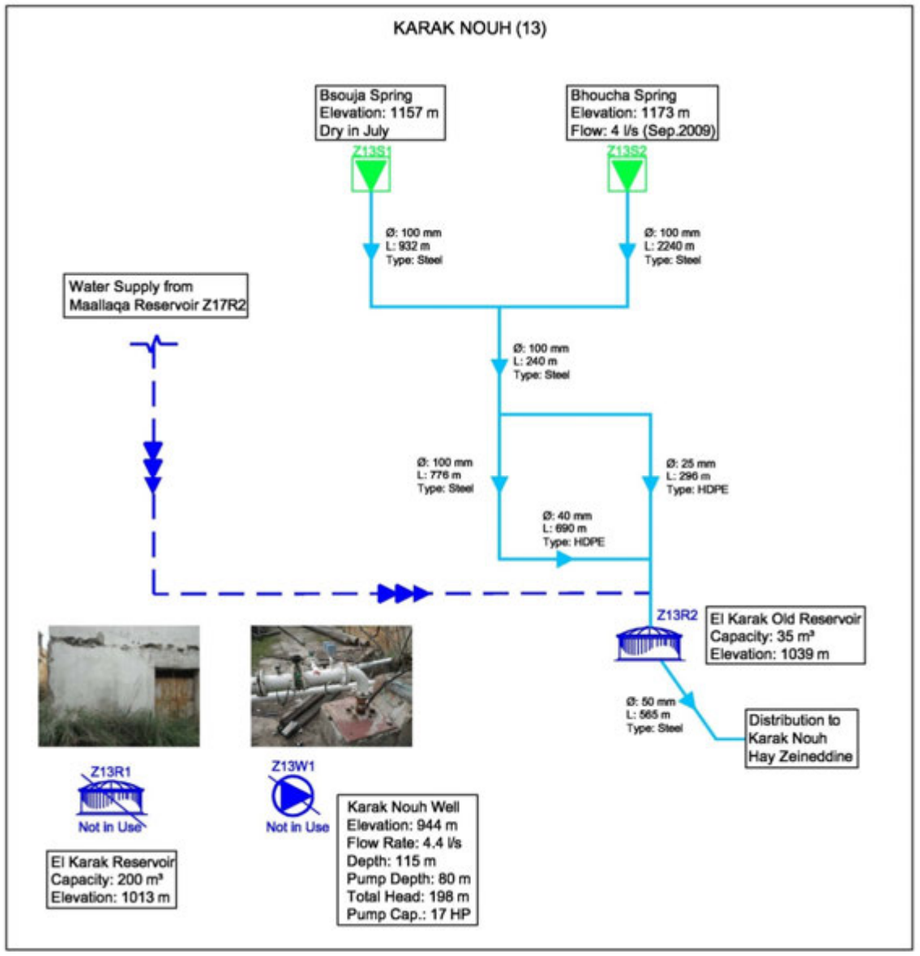
The existing water network is in bad condition and it has a length of around 14.5 km. It covers a large area of the town.

Well Z12W1 (50 years old) & Well Z13W3: This well is constructed 50 years ago. It is in acceptable condition but it suffers from a shortage of electric power.

Well Z12W2: This well was constructed 20 years ago and rehabilitated in year 2010.
It is in good condition but it suffers from a shortage of electric power. A same transformer is used for the three wells.

Reservoir Z12R1 (>45 years; 500 m³): This reservoir was rehabilitated in year 1997 and it is in good condition. Some of its pipes are rusted and need to be changed. This reservoir needs some minor maintenance.

Karak Nouh (13)



The existing water network is very old (more than 30 years) and it is in bad condition. This network includes only two main pipe lines.

Well Z13W1 (50 years old): Well is not in use because it is muddy. It needs cleaning and rehabilitation or new boring. A chlorination room exists but it is not equipped.

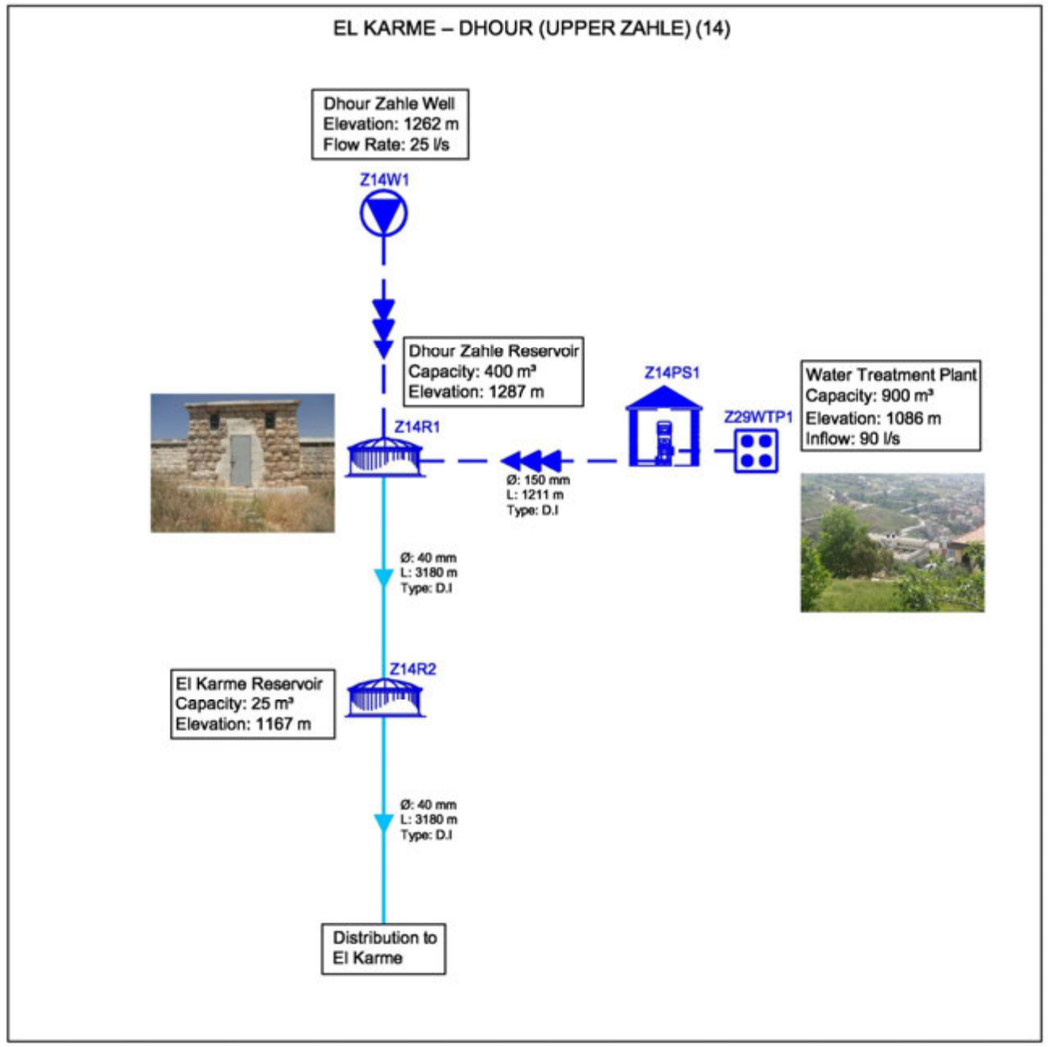
Spring Z13S1: this spring was dry during visit time.

Spring Z13S2: This spring has a flow around 4 l/s (in September 2009). No more available information.

Reservoir Z13R1 (200 m³): Reservoir is very old but it is in bad condition. Its pipes are rusted and need to be changed. This reservoir needs structural and architectural rehabilitations or reconstruction. This reservoir is not in use anymore.

Reservoir Z13R2 (35 m³): Reservoir is very old. No more available information.

El Karme – Dhour (Upper Zahle) (14)



There is an old network in El Karme but it is in acceptable condition.

Well Z14W1: No available information.

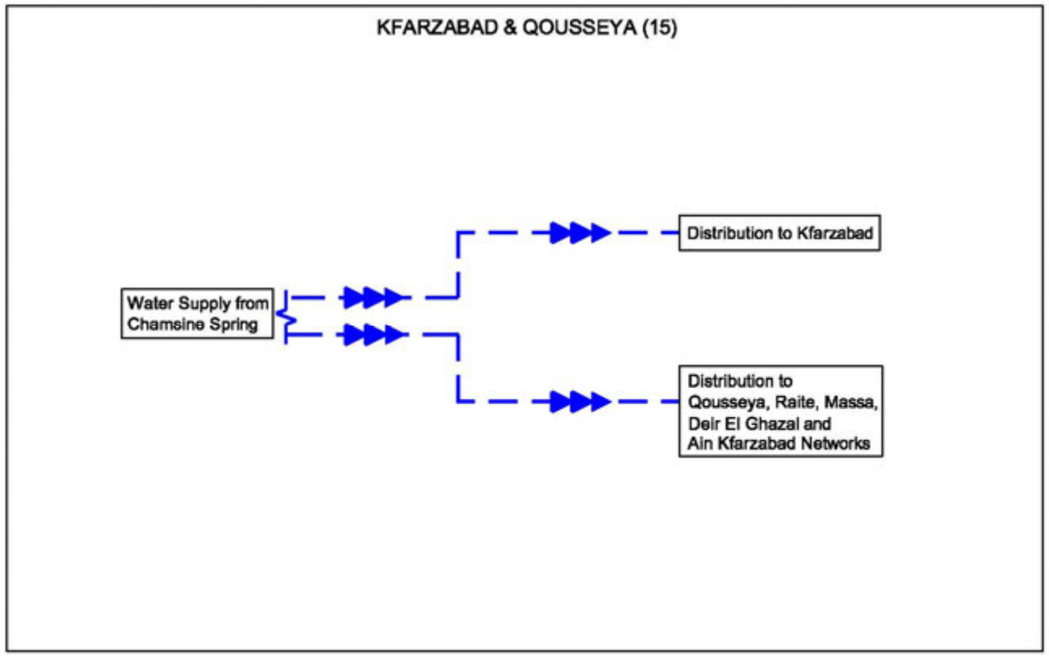
Pump station Z14PS1: Pump station is old. Some pipes are rusted and they need to be changed. This pump station needs rehabilitation.

Water treatment plant Z29WTP1: Refer to Zahle water treatment plant section.

Reservoir Z14R1 (>60 years; 400 m³): Reservoir is very old. It needs rehabilitation or reconstruction.

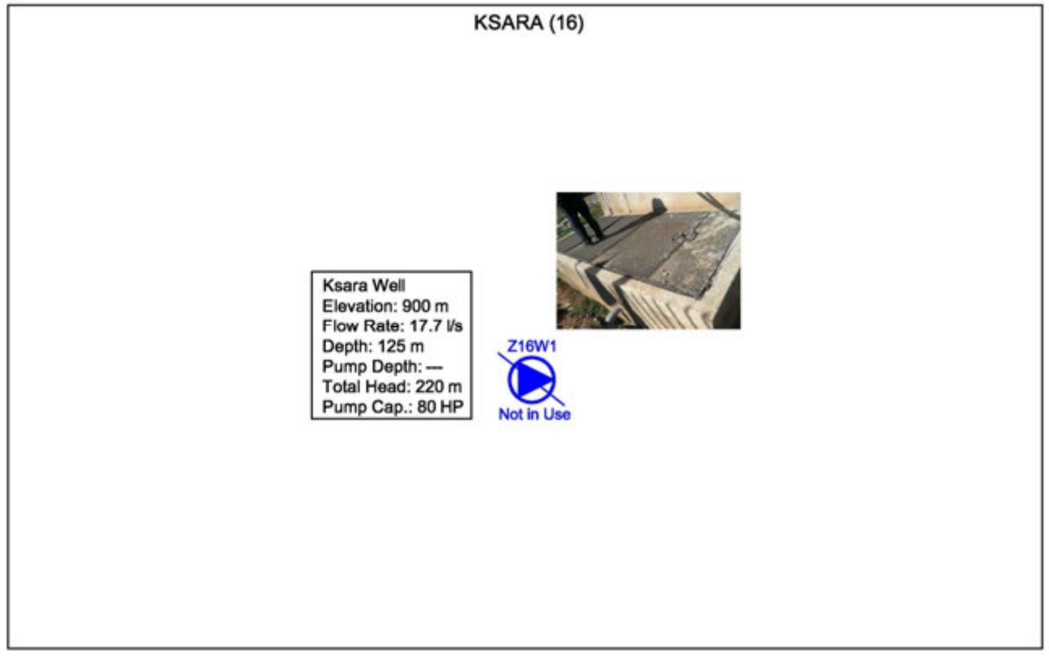
Reservoir Z14R2 (25 m³): No available information.

Kfarzabad & Qousseya (15)



The existing water network is in very good condition and it has a length of around 48 km. It covers a large area of the town.

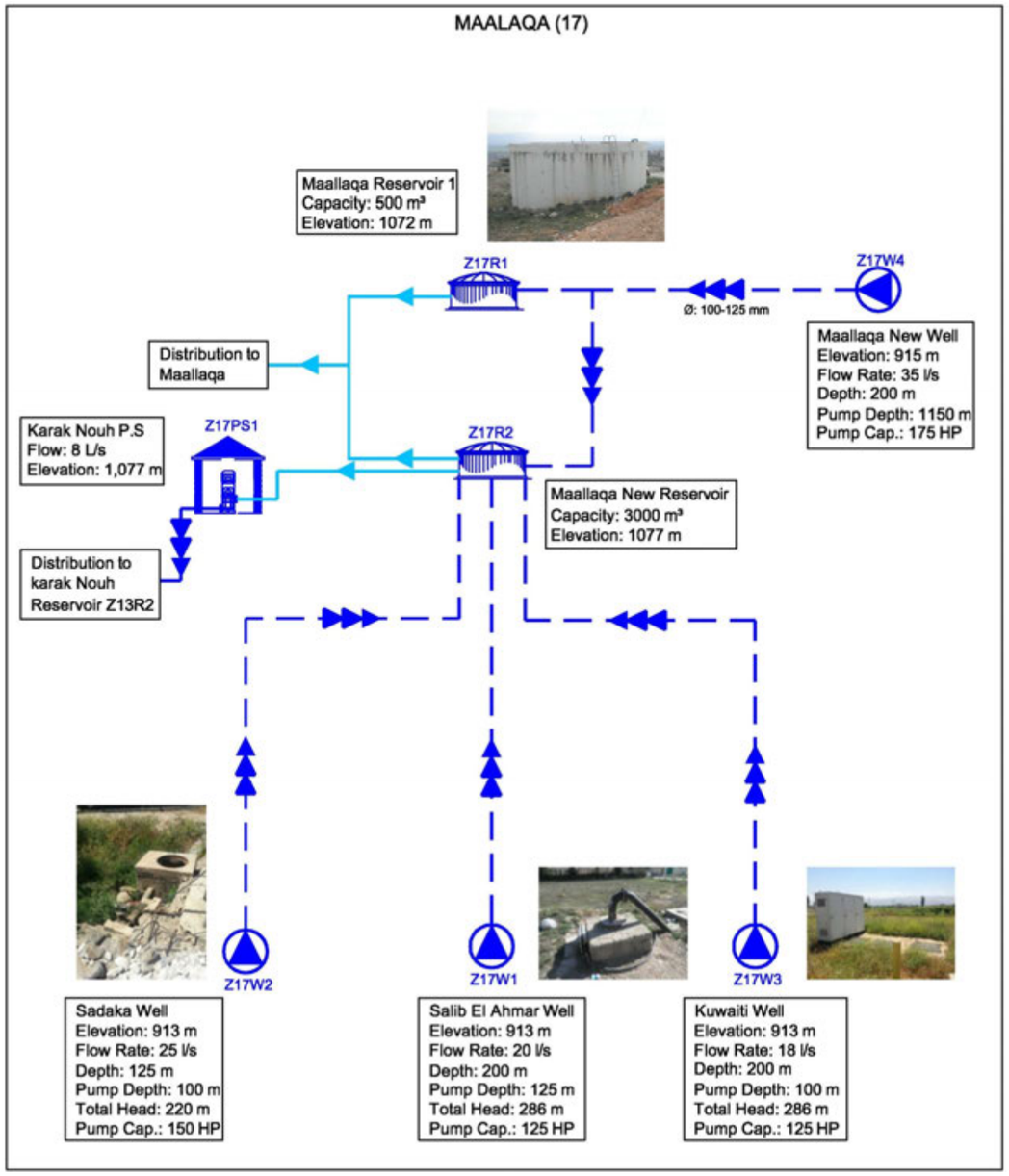
Ksara (16)



Water is supplied from Haouch El Oumara new network.

Well Z16W1: well is not in use. It has a chlorination system.

Maalaqa (17)



The existing water network is in bad condition and it has a length of around 20 km. It covers a large area of the town.

Well Z17W1 (>5 years): Well is old but it is in acceptable condition. The panel board is far from the well and it suffers from a shortage of electric power. This well needs fence and security.

Well Z17W2 (5 years old): Well is old but it is in acceptable condition. It suffers from a shortage of electric power and it is subjected to leakage. This well needs fence and security. It has a chlorination unit but it is not operational. This well needs rehabilitation.

Well Z17W3: Well is very old. It suffers from a shortage of electric power and it is subjected to leakage. This well needs fence and security. A new pump must be installed instead of the existing one because the last is not working. This well needs rehabilitation.

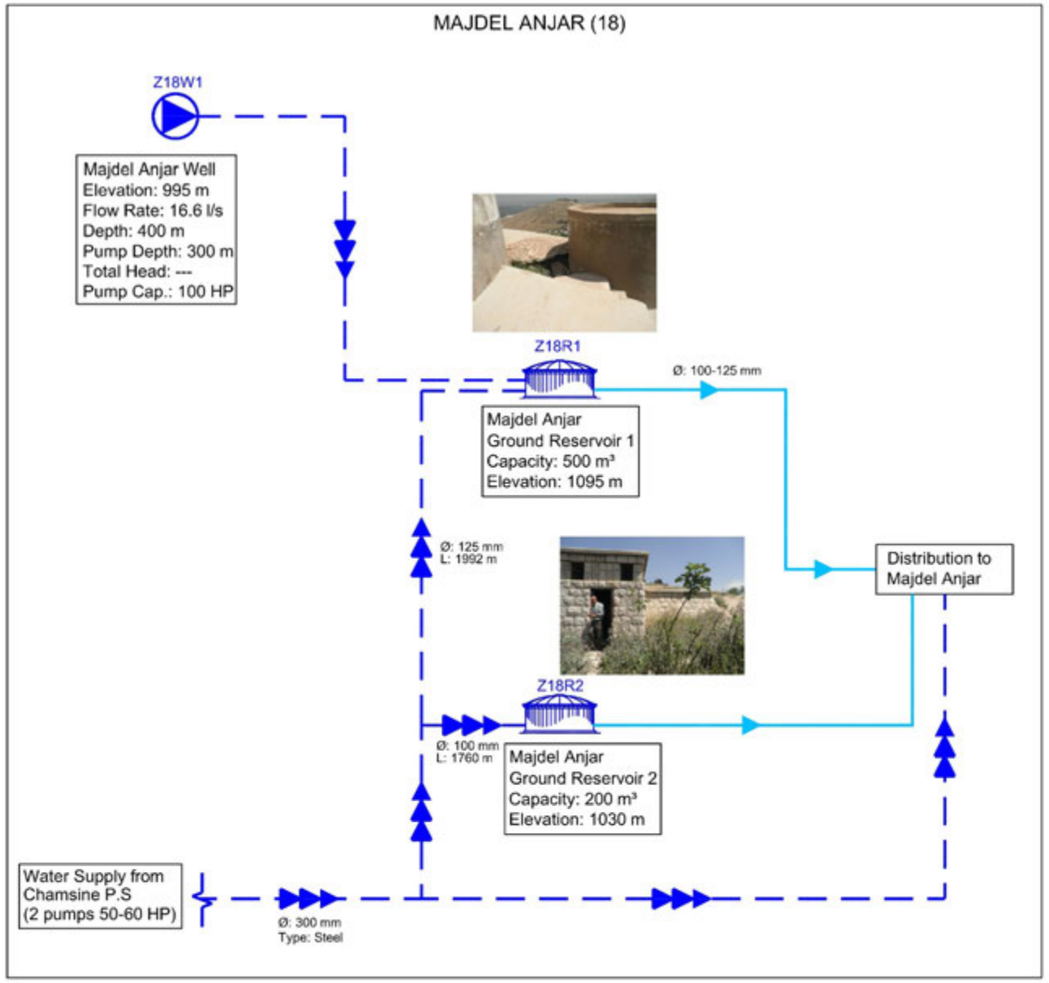
Well Z17W4 (<2 years): Well is new and it is in good condition.

Pump station Z17PS1 (<2 years): Pump station is new and it is in good condition.

Reservoir Z17R1 (>15 years; 500 m³): Reservoir is very old but it is still in use due to shortage of storing units. Its pipes are rusted and need to be changed. This reservoir needs rehabilitation.

Reservoir Z17R2 (3000 m³): Reservoir is new and it is not in use yet. It was supposed to be fed by Zahle treatment plant. A new chlorination equipment and building was built. However, the connecting pipes between Zahle WTP and this reservoir are very old and need to be changed.

Majdel Anjar (18)



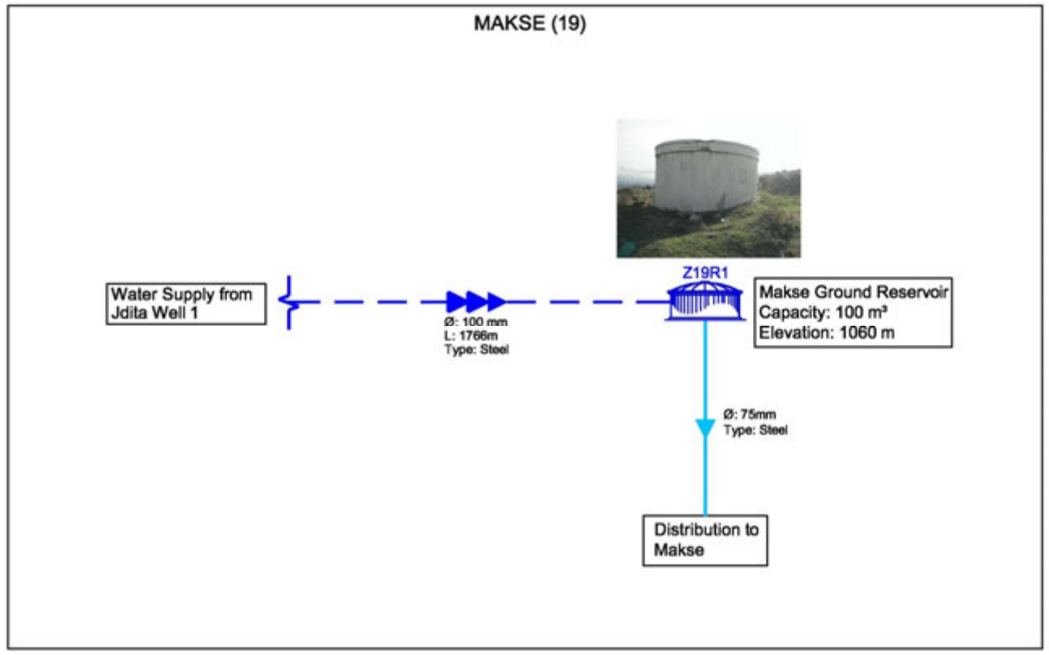
The existing water network is in very good condition and it has a length of around 77 km. It covers a large area of the town.

Well Z18W1 (>5 years): This well was constructed 7 years ago. It is not in bad condition but it suffers from a shortage of electric power.

Reservoir Z18R1 (55 years old; 500 m³): Reservoir is old and it is in bad condition. It needs esthetical and structural rehabilitations.

Reservoir Z18R2 (>25 years; 200 m³): Reservoir is very old and in bad condition. It needs reconstruction.

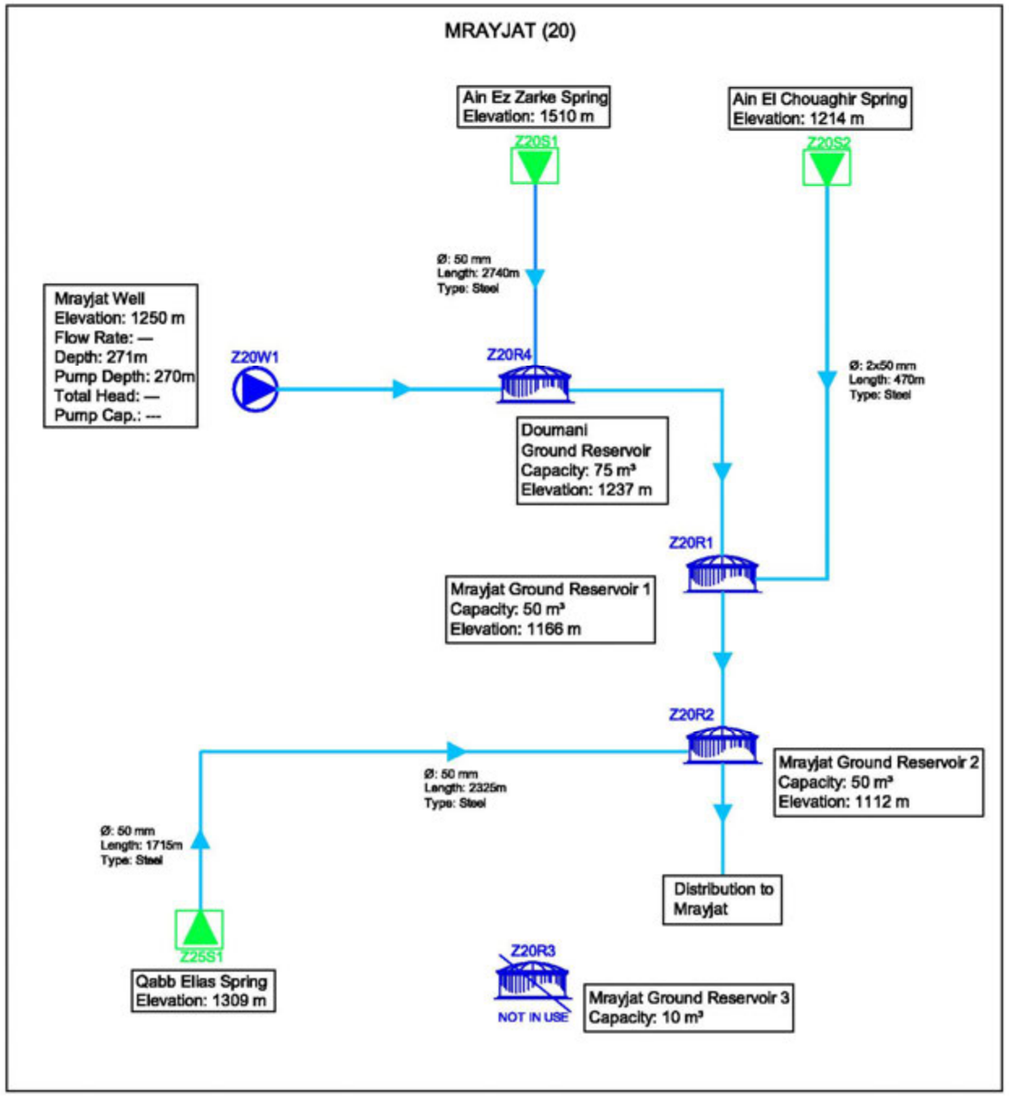
Makse (19)



The existing water network is in good condition and it has a length of around 4 km. It covers a large area of the town.

Reservoir Z19R1 (>45 years; 100 m³): Reservoir is old. It needs some maintenance and esthetical rehabilitation.

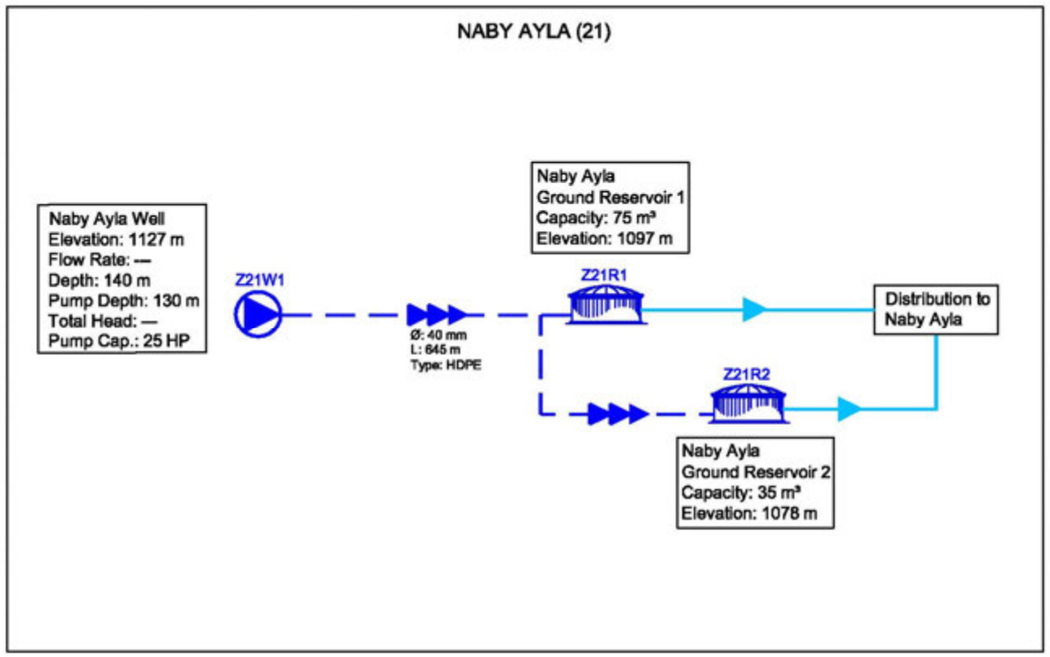
Mrayjat (20)



No available information.

Well Z20W1 (>10 years), Springs Z20S1, Z20S2, Reservoirs Z20R1, Z20R2, Z20R3 & Z20R4:
No available information.

Naby Ayla (21)



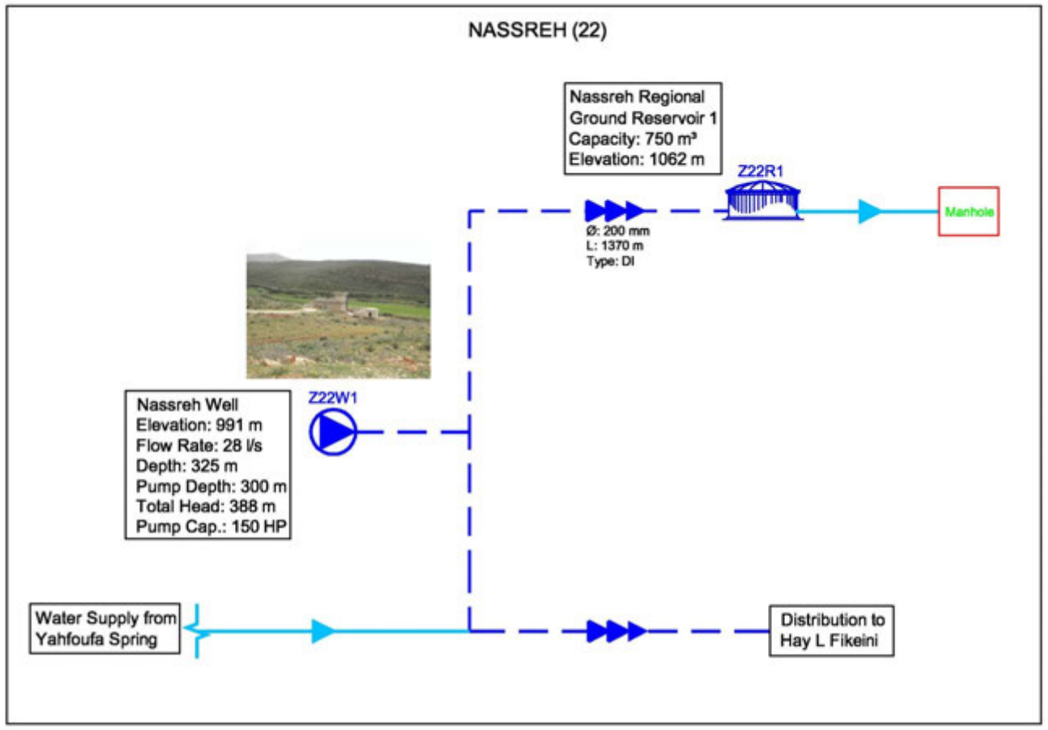
The existing water network is in good condition and it has a length of around 1.5 km. It covers a small part of the town.

Well Z21W1 (55 years old): Well is not accessible.

Reservoir Z21R1 (75 m³): No available information.

Reservoir Z21R2 (35 m³): No available information.

Nassreh (22)

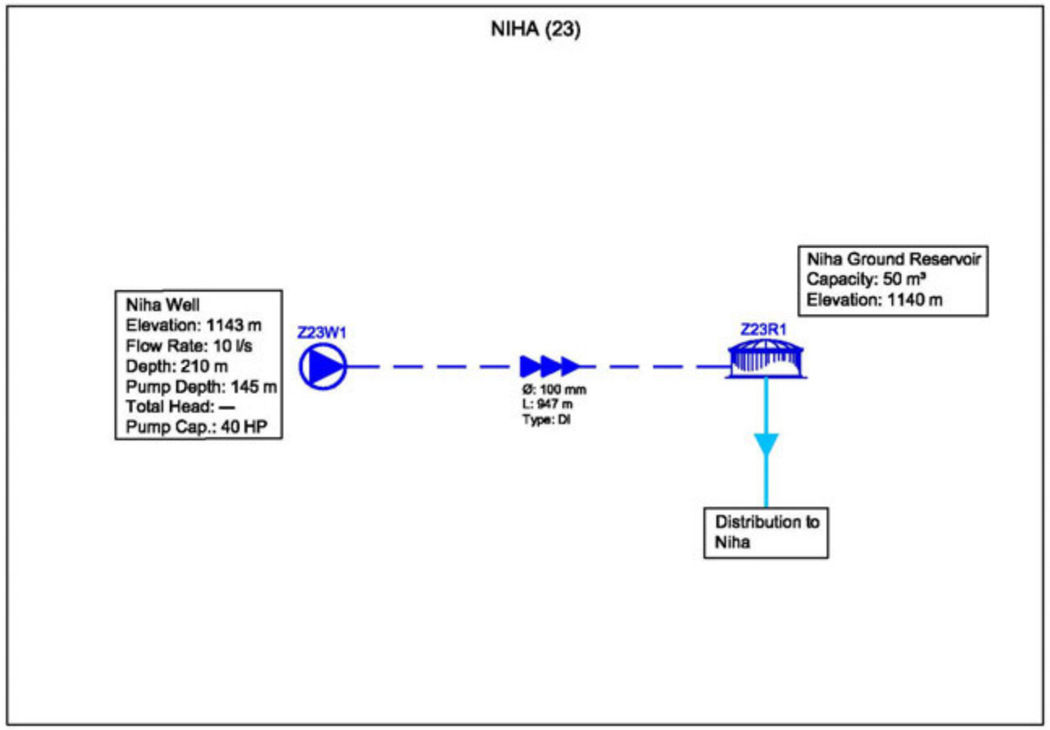


The existing water network is in bad condition and it has a length of around 12 km.

Well Z22W1 (20 years old): Well is in good condition after it was rehabilitated lately this year. It is suffer from a shortage of electric power and there is no chlorination unit.

Reservoir Z22R1 (750 m³): No available information.

Niha (23)

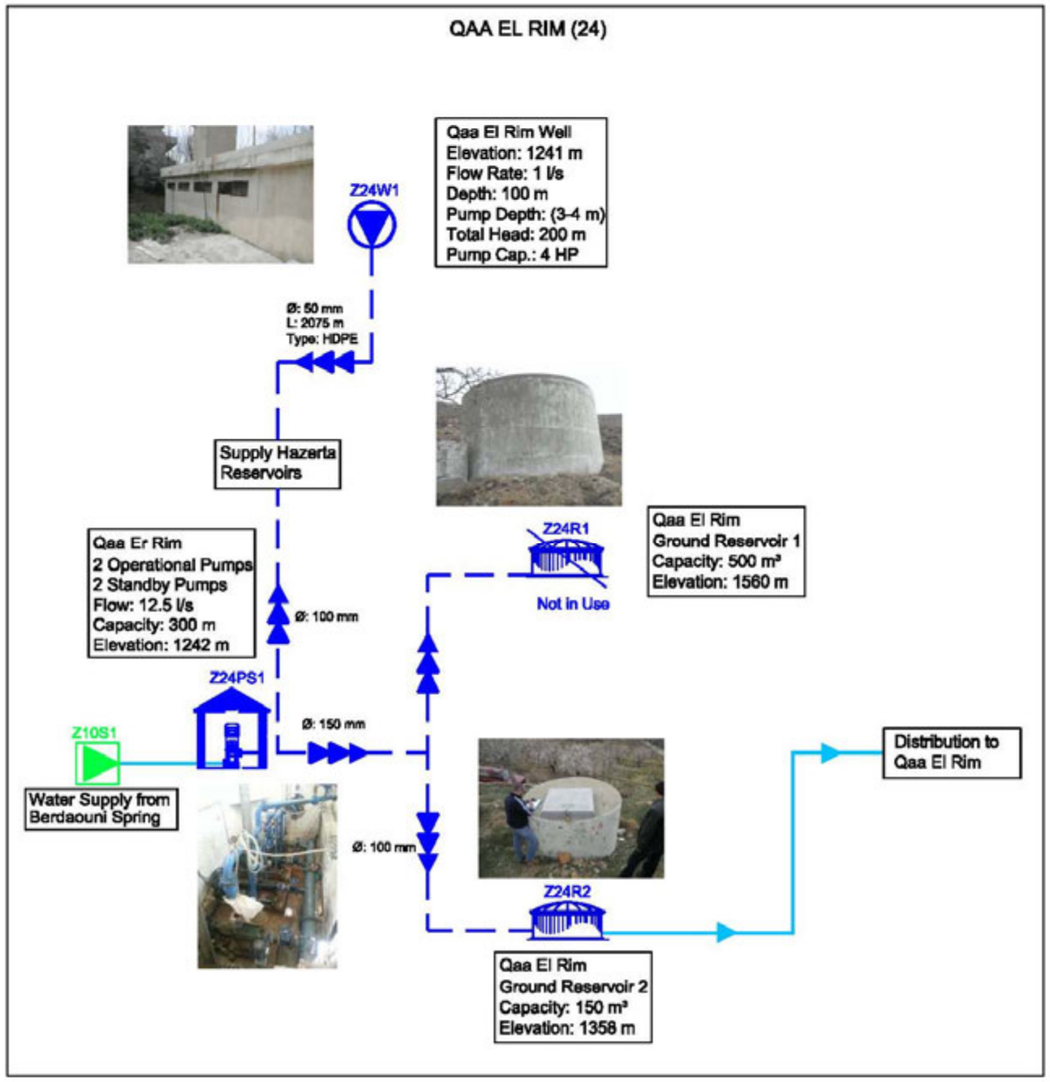


The existing water network is new (year 2013) and it is in a good condition.

Well Z23W1 (>10 years): Well is not accessible.

Reservoir Z23R1 (50 m³): No available information.

Qaa el rim (24)



The existing water network is in bad condition and it has a length of around 10 km. It covers a large area of the town.

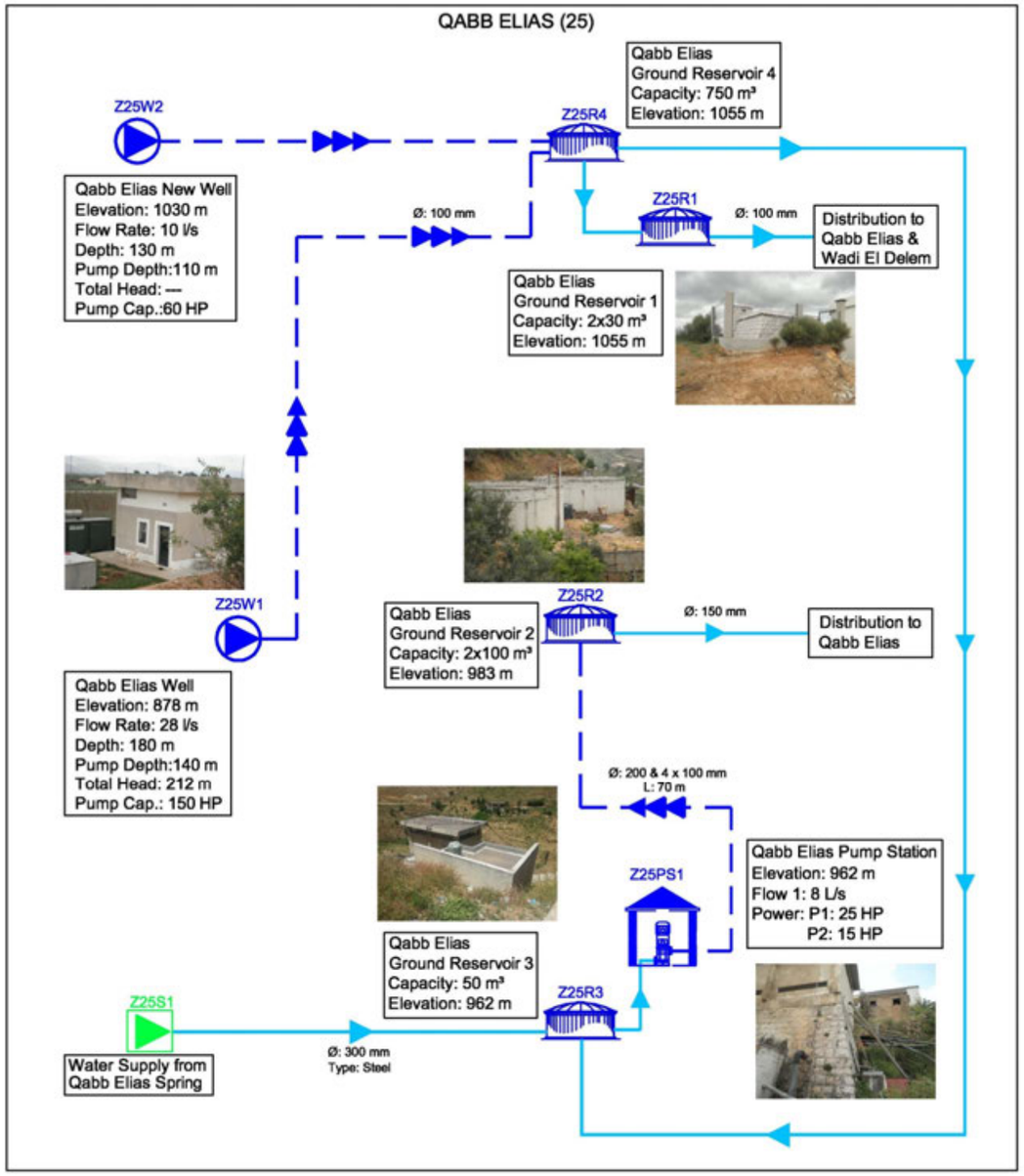
Well Z24W1: well supplies water to Hazerta village. Well is in acceptable condition.

Pump station Z24PS1: pump station is very old. It includes a pump chamber, chlorinator and monitoring room. It contains 4 pumps. Two of them pump water to Qaa El Rim and Hazzerta respectively, and the other two are standby pumps used for emergency.

Reservoir Z24R1 (15 years old; 500 m³): reservoir is not in use. Valve chamber of this reservoir is inaccessible. It needs aesthetical rehabilitation.

Reservoir Z24R2 (45 years old; 150 m³): reservoir is old (more than 40 years).valve chamber of this reservoir is not accessible. It is subjected to leakage and the water indicator is broken. This reservoir needs some minor maintenance.

Qabb Elias (25)



The existing water network is in bad condition and it has a length of around 3.5 km. It covers a large area of the town.

Well Z25W1 (20 years old): Well is not in bad condition but it suffers from a shortage of electric power.

Well Z25W2 (<2 years old): Well is new and it is in good condition. Its pump is solar powered.

Spring Z25S1: The estimated safe yield adopted for this spring is about 341 l/s.

Pump station Z25PS1: Pump station is old and needs some minor maintenance because it is subjected to leakage.

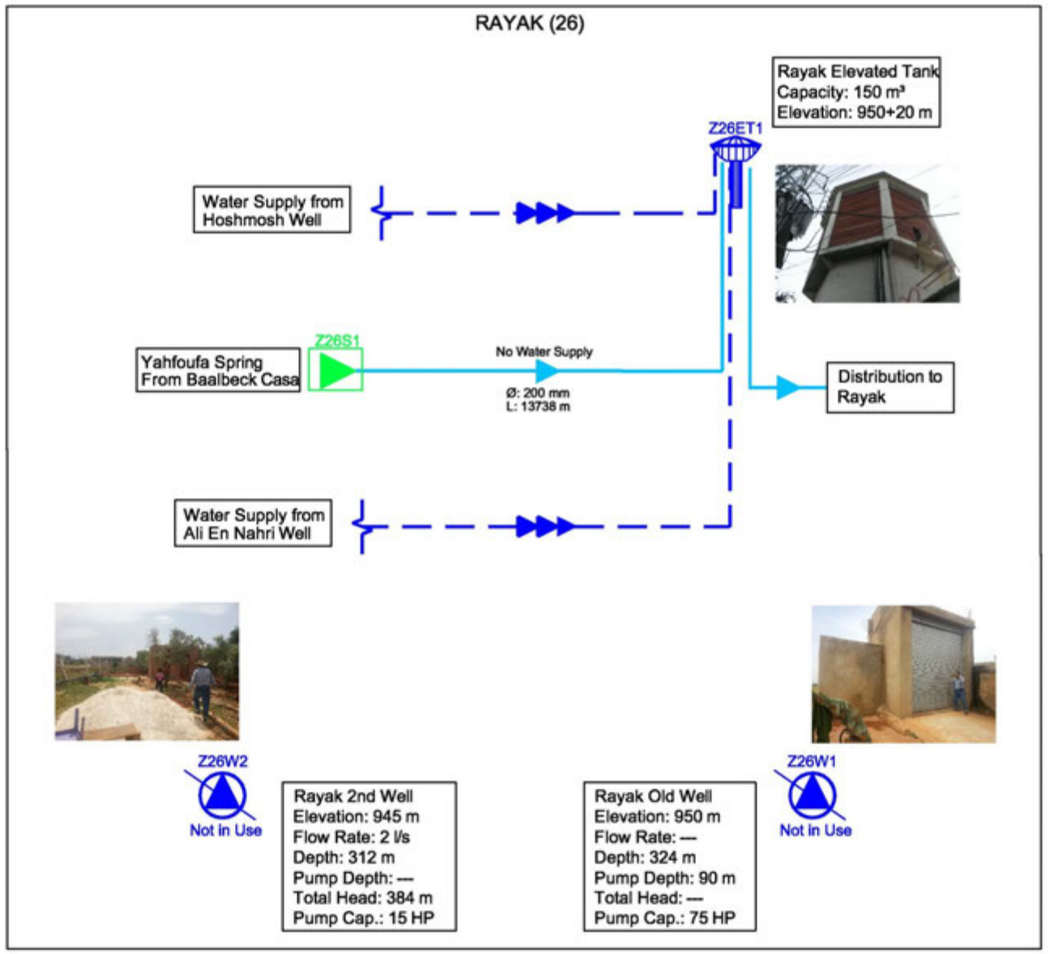
Reservoir Z25R1 (2x30 m³): Reservoir is very old and still operating but it is not in bad condition. Its valve chamber is inaccessible. It needs some minor maintenance. A new reservoir was constructed next to it but it is still not in use.

Reservoir Z25R2 (2x100 m³): Reservoir is in good condition. Some minor maintenance was done lately for valves and pipes. Its roof shall be cleaned from debris.

Reservoir Z25R3 (50 m³): Reservoir is very old but still operational. Some valves and pipes need to be changed. Chlorine cylinders are missing.

Reservoir Z25R4 (750 m³): Reservoir is new but it is still not in use.

Rayak (26)



The existing water network is in good condition and it has a length of around 13 km. It covers a part of the town.

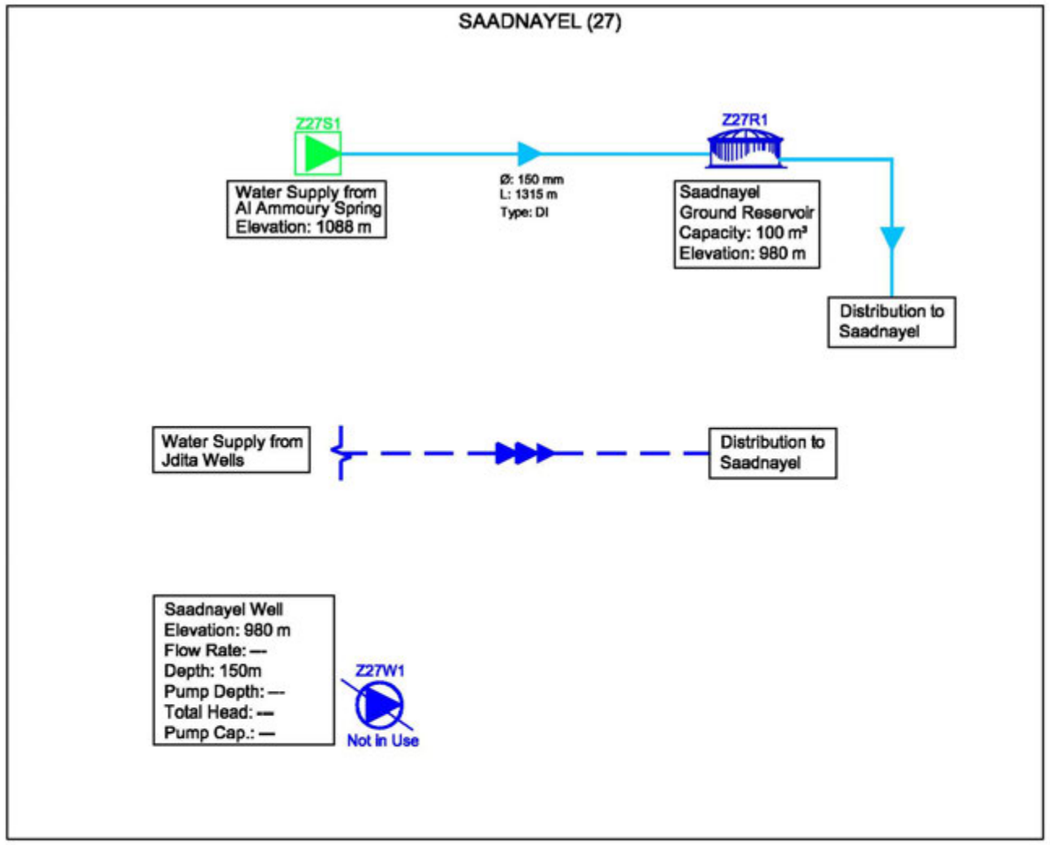
Well Z26W1 (30 years old): Well is in acceptable condition, but it is not in use.

Well Z26W2 (30 years old): Well is in acceptable condition, but it is not in use.

Spring Z26S1: Spring is tainted with nitrate and it is not supplying water to Rayak elevated tank anymore. This spring is located in Baalbeck casa. It has a chlorination room with no chlorination units. Its main valve is subjected to leakage.

Elevate tank Z26ET1 (150 m³): Elevated tank is in acceptable condition. Its pipes are rusted and need to be changed. This elevated tank needs minor maintenance.

Saadnayel (27)



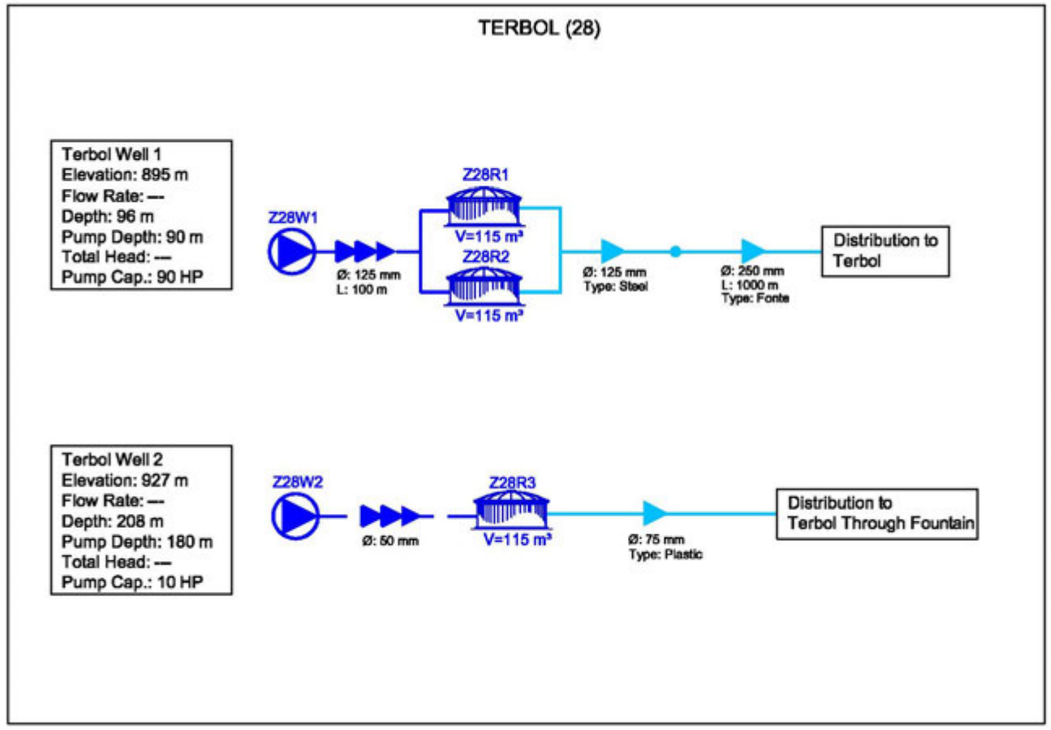
The existing water network is in bad condition and it has a length of around 13 km. It covers a large area of the town.

Well Z27W1 (20 years old): Well is neither operational nor equipped. Its room is full of water due to leakage. It needs rehabilitation.

Spring Z27S1: No available information.

Reservoir Z27R1 (100 m³): No available information.

Terbol (28)



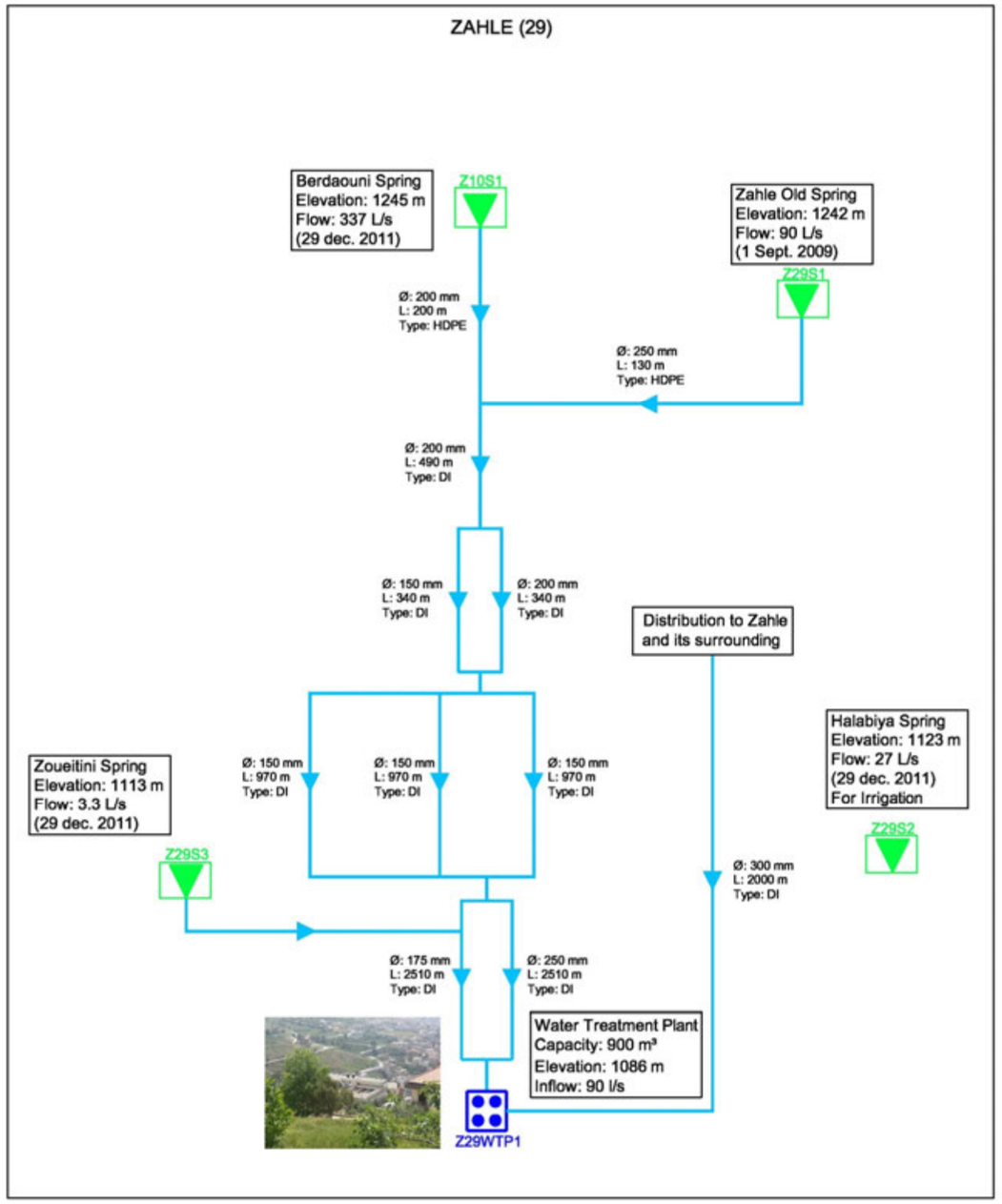
The existing water network is in medium condition and it has a length of around 7 km. It covers a large area of the town. There are two formal wells in the town but they don't meet the people's water needs. Most of terbol people have their own wells.

Well Z28W1 (30 years old): Well is tainted with nitrates and it needs rehabilitation. The people of the town uses this well only for domestic purposes.

Well Z28W2 (10 years old): Well is not connected to a network; however it supplies water to people through a fountain located in the town. No more information about the status of this well.

Reservoir Z28R1 (115 m³), Z28R2 (115 m³) & Z28R3 (115 m³): Reservoirs are very old. No more available information.

Zahle (29)



The existing water network is in bad condition and it has a length of around 218 km. It covers a large area of the town.

5 WEST BEKAA CAZA

5.1 Water Networks

Table 5-1 summarizes the results of the data collection campaign carried out through the questionnaires and over the phone. Twenty two municipalities were contacted and all of them answered affirmatively regarding the existence of a water network. Of those, only the existing networks of Raouda and el Marj were obtained. For most of the other villages, the networks are very old and are being replaced. Hence the newly constructed networks for 12 villages were obtained along with 2 planned networks (all designed by RELK&P in 2010 and funded by the CDR). The networks of the following villages could not be obtained: Khirbet Qanafar, Lala, Libbaya, Qaraoun, Sohmor, and Yohmor El Bekaa.

Figures 5-1 and 5-2 show that 9% of the West Bekaa population, representing 27% of the caza villages, is not served by any water networks (existing or planned), while 91 % of the population representing 73% of the villages will be served by existing or planned networks. A large number of these networks have been executed very recently (in the last 1 or 2 years) to replace old networks.

Plans 5-1, 5-2 and 5-3 show the layout of the existing and planned water networks (whenever available) for the caza of West Bekaa as a whole, and the areas of north and northeast West Bekaa respectively.

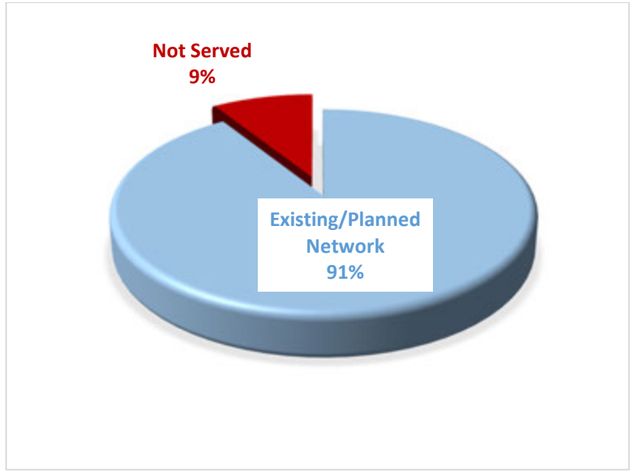


FIGURE 5-1: PERCENTAGE OF POPULATION SERVED BY WATER NETWORKS IN WEST BEKAA CAZA

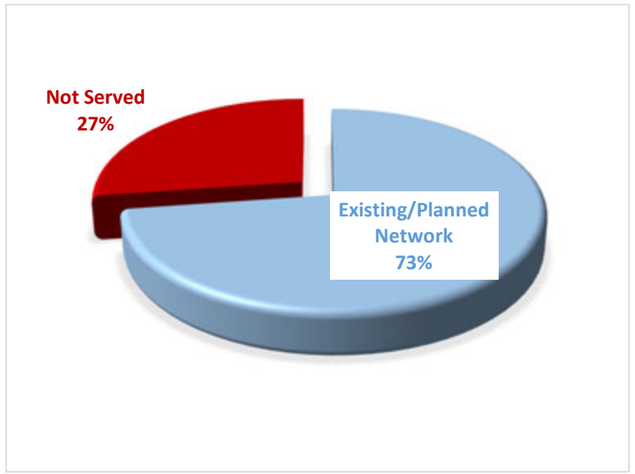
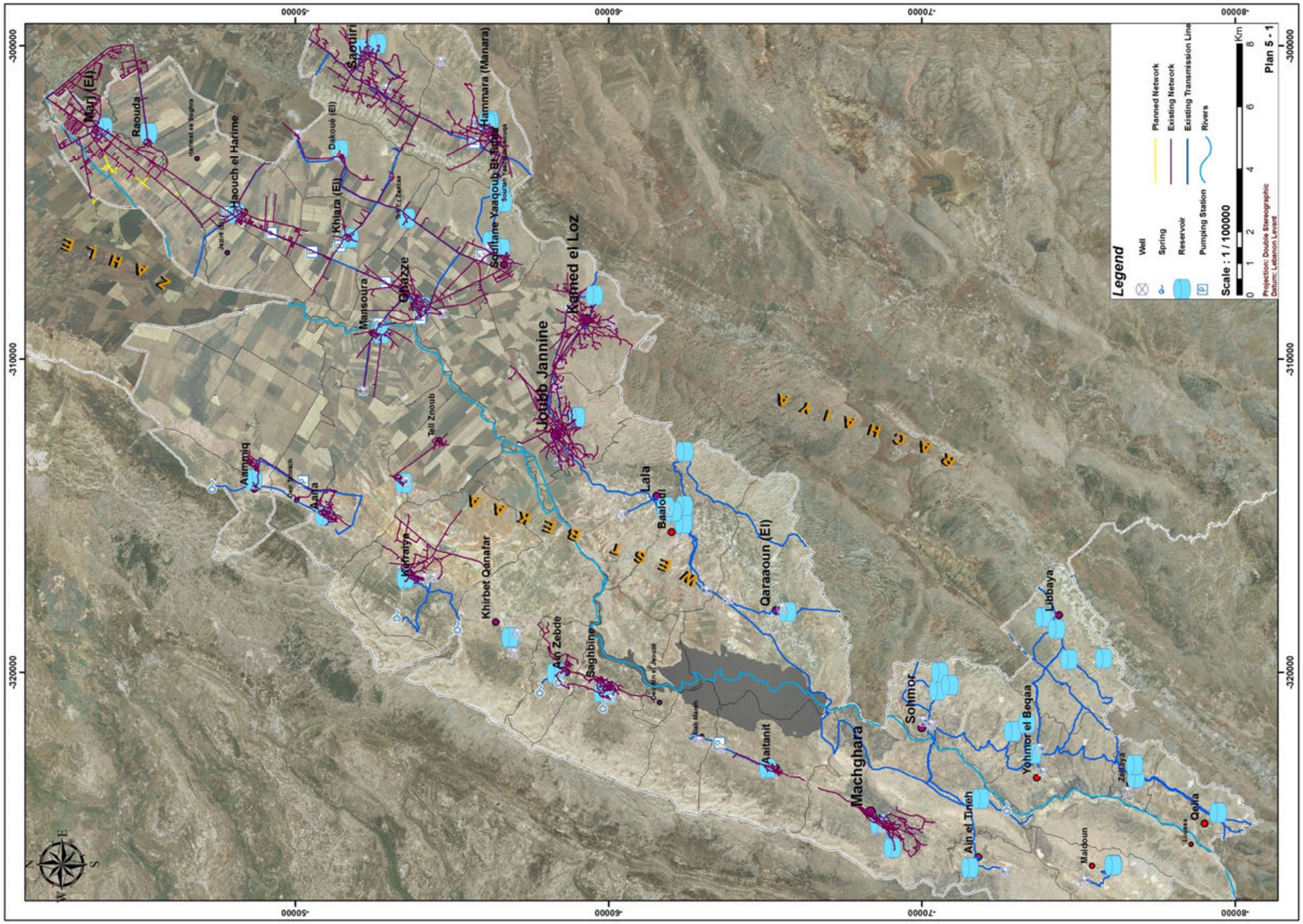


FIGURE 5-2: PERCENTAGE OF VILLAGES SERVED BY WATER NETWORKS IN WEST BEKAA CAZA

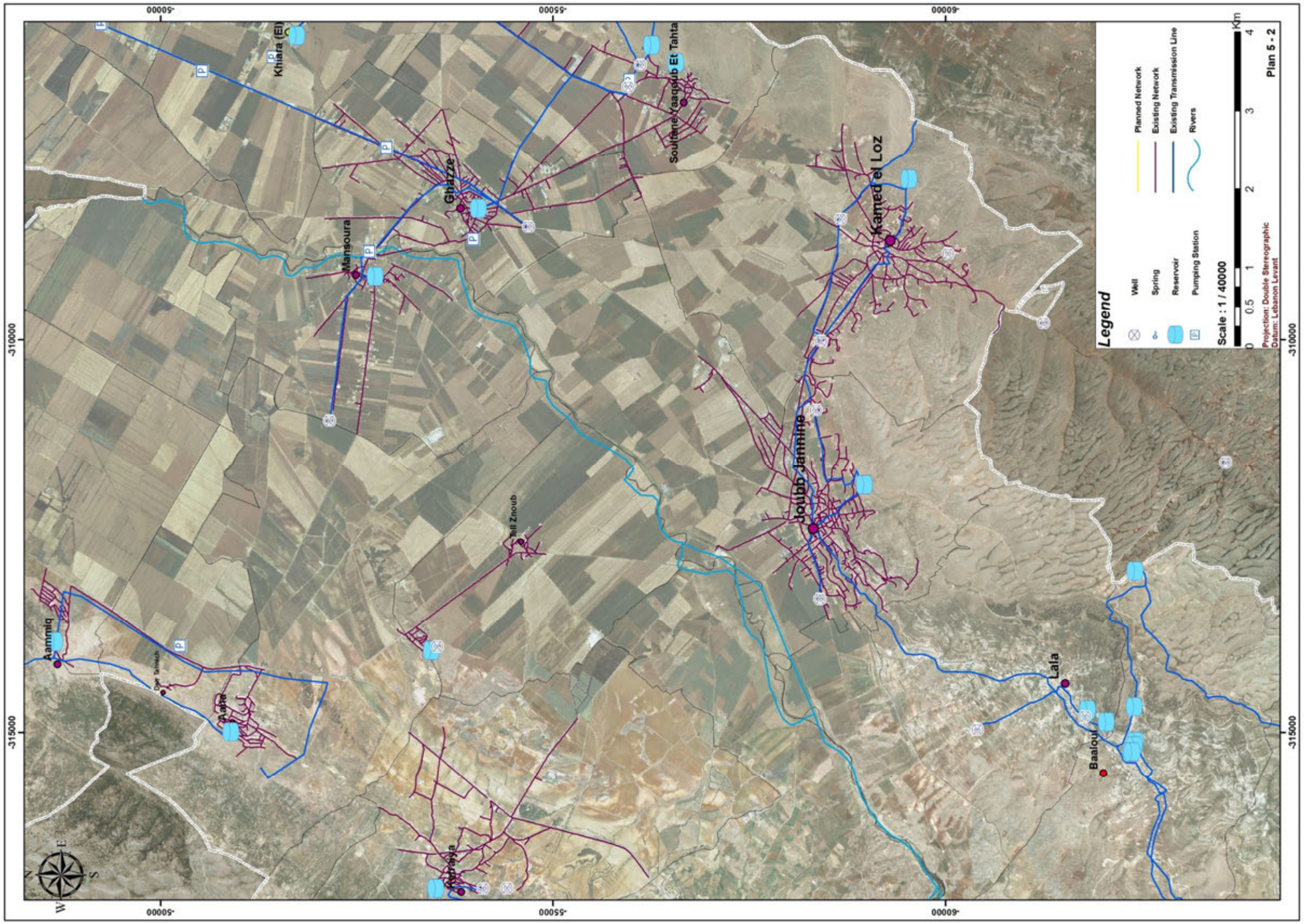
TABLE 5-1: WATER NETWORK STATUS IN CAZA OF WEST BEKAA

Caza		Village name	Information from questionnaire/phone interview						Response of municipality to phone request for water maps	Network maps availability status
			Wells	Srping	Water network	Water source	Network construction date (year)	Status of water network according to municipality		
West Bekaa	1	Aaitanit	No answer	No answer	Yes	Artesian Well	Under construction	No answer	Told us to go to the CDR	Obtained - newly constructed
	2	Aana	No	No	Yes	No Answer	1956	* Network is very old (bad condition) * A new network will be installed during summer	Did not call - data already available	Obtained - newly constructed
	3	Ain Zebdé	Yes	No	Yes	Springs	50 years old	* Network is very old (bad condition)	Not available at municipality	Obtained - newly constructed
	4	Haouch El Harime	No	No	Yes	Chamsine Spring	2010	* Network is in good condition	Told us to call Nasma company (engineer Ahmad Hajar Tel : 03749049)	Obtained – planned network
	5	Joubb Jannine	Yes	No	Yes	Wells	60 years old	* Network is very old (bad condition) * A new network will be installed during summer	No answer	Obtained - newly constructed
	6	Kamed El Loz	Yes	No	Yes	Wells	60 years old	* Network is very old (bad condition)	Not available at municipality	Obtained - newly constructed
	7	Kefraiya	Yes	Yes	Yes	Spring & Well	15 years old	* Network is very old (bad condition)	Not cooperative	Obtained - newly constructed
	8	Khiara (El)	No	No	Yes	Chamsine Spring	2011-2012	* New network was installed	Told us to go to K&A consultant company	Obtained – planned network
	9	Khirbet Qanafar	Yes	Yes	Yes	Springs & Well	2003	* Network is in good condition. * pipe diameter ranges between 400 mm and 110 mm.	Told us to contact Nazih Breidy company	Not obtained (Nazih Breidy said maps are not available)
	10	Lala	Yes	No	Yes	Well	10 years old	* Network is in good condition. * Pipe diameter ranges between 0.5" and 5". * Network length is around 17.8 km. * Main pipe between well and reservoir is updated	Told us they don't know where maps can be obtained from	Not obtained
	11	Libbaya	No answer	No answer	Yes	Yahmour & Private Well	1975 - 2005	* New and old networks are connected together	Municipality promised to help but did not follow through	Not obtained
	12	Manara	Yes	No	Yes	Well	1970	* Network is very old (bad condition) * A new network was designed but not installed	Not available at municipality	Obtained - newly constructed
	13	Mansoura	Yes	No	Yes	Well	1998	* Old network is in medium condition * pipe diameter ranges between 0.5" and 6".	Told us to contact council for the south	Obtained - newly constructed
	14	Marj (El)	No	No	Yes	Chamsine Spring	2013	* New network was installed and it is in good condition	Told us to contact CDR	Obtained - existing network

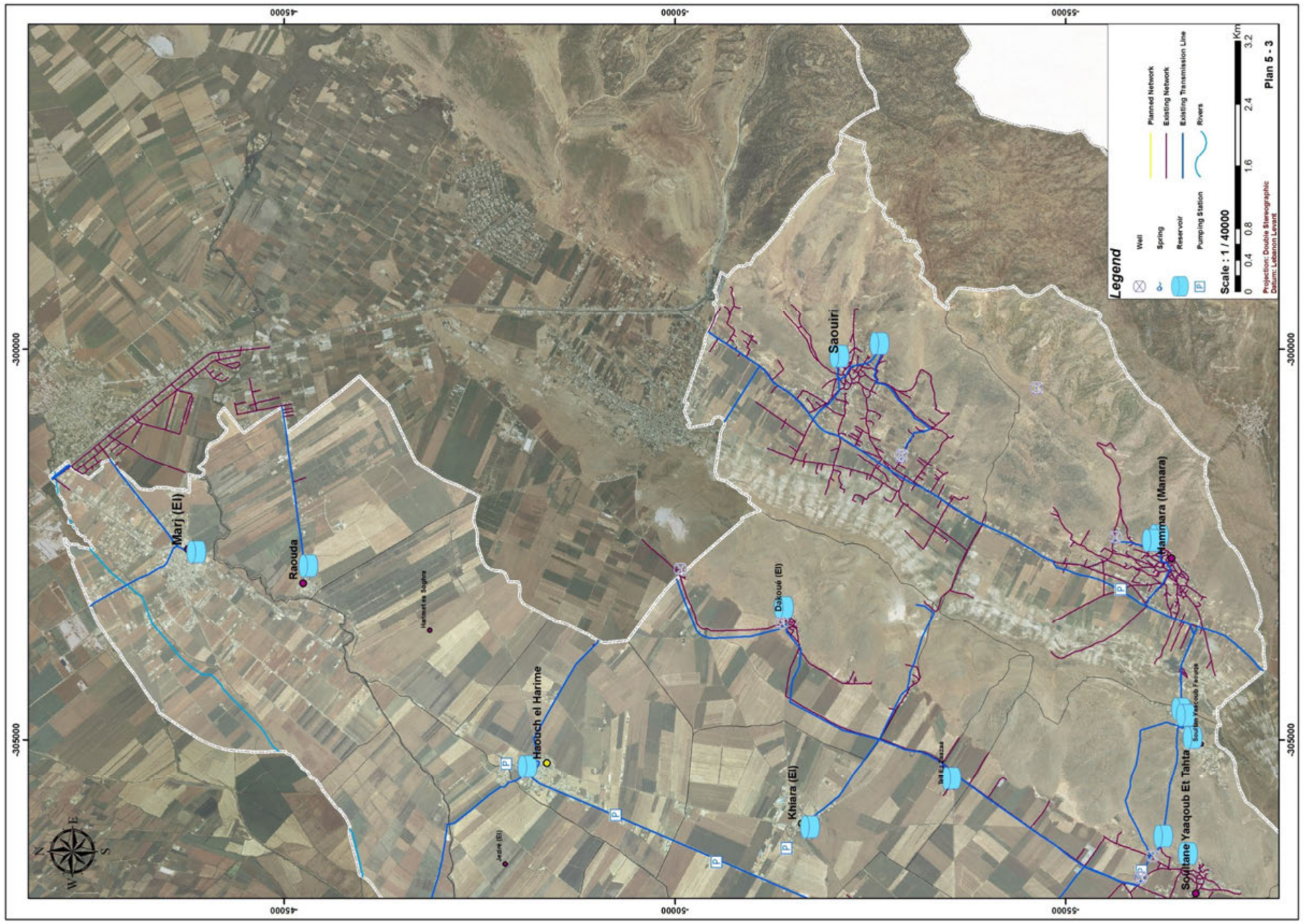
Caza		Village name	Information from questionnaire/phone interview						Response of municipality to phone request for water maps	Network maps availability status
			Wells	Srping	Water network	Water source	Network construction date (year)	Status of water network according to municipality		
	15	Qaraaoun (El)	Yes	No	Yes	Chamsine Well & Private Well	2000	* Old network was replaced by a new one in year 2000	Told us to contact Breidy company	Not obtained (Nazih Breidy said maps are not available)
	16	Raouda	No	No	Yes	Anjar Spring	2010 - 2012	* New water network installed	Not available at municipality	Obtained - existing network
	17	Saghbine	Yes	Yes	Yes	Wells	60 years old new is under construction	* Network is very old (bad condition) * New network is under construction	Municipality promised to help but did not follow through	Obtained - newly constructed
	18	Saouiri	No answer	No answer	Yes	Balad Reservoir	1950	* Network is very old (bad condition)	Not available at municipality	Obtained - newly constructed
	19	Sultan Yaqoub El Fouqa (Sultan Yaqoub El Tahta)	No	No	Yes	Reservoir - Wells	20 years old	* Network is very old (bad condition)	Told us to contact ministry of energy and water	Not obtained Sltan Yaqoub el Fouqa obtained - newly constructed network of Sltan Yaqoub el Tahta
	20	Sohmor	No answer	No answer	Yes	No Answer	Old and new	* Network is very old (bad condition) * old network is updated	Not available at municipality	Not obtained
	21	Tell Znoub (New & Old)	Yes	No	Yes	Reservoir - Well	1950	* Network is very old (bad condition) * New network is under construction	Promised to help but did not follow through	Obtained - newly constructed
	22	Yohmor El Beqaa	Yes	No	Yes	Chamsine Spring	18 years old & new one lately	* Old network is very old (bad condition)	Promised to help but did not follow through	Not obtained



PLAN 5-1: WATER SYSTEMS FOR CAZA OF WEST BEKAA



PLAN 5-2: WATER SYSTEMS FOR CAZA OF WEST BEKAA – NORTH



PLAN 5-3: WATER SYSTEMS FOR CAZA OF WEST BEKAA - NORTHEAST

5.2 West Bekaa Water Facilities

In the caza of West Bekaa the layout of the water facilities, along with their assessment are included for 36 localities. The other 8 localities do not have any BWE facilities. Some of these villages are supplied with water from another village (in which case this will be shown on the schematics of that village), while the others rely on private wells and/or non-serviced sources or on privately acquired water. As can be seen on some of the layouts, some facilities are not connected to the system because no information could be obtained about their position relative to the other facilities.

In the caza of West Bekaa, there are reservoirs of all sizes: 31% have a capacity of less than a 100 m^3, 9 % have a capacity larger than 2000 m^3, and 57 % have a capacity between 100 and 1000 m^3 distributed almost equally between the ranges 100-200 m^3; 200-500 m^3; and 500-1000 m^3 . Only 3% have a capacity between 1000 and 2000 m^3 (figure 5-3).

As shown in figure 5-4, 19 % only of all the reservoirs (ground reservoirs and elevated tanks) were found to be in good condition, another 19% need minor improvements and/or maintenance, while 48% need major rehabilitation or reconstruction. For about 14 % of the reservoirs, not enough information to conduct an assessment could be gathered. As for the wells, they are divided in two categories, namely functional and non-functional. However, a functional well may need various types of improvements to become efficient as it could be providing water intermittently or insufficiently. Overall, 82 % of the West Bekaa wells are currently functional (figure 5-5),

In addition to the water systems layouts per village, the system layouts for the Ain El Zarqa spring and the Sultan Yacoub regional reservoir are included. The Ain El Zarqa system has been partly constructed but is not functional yet because of various constraints such as the unavailability of enough electric power. In fact, this system relies on two large pumping stations (one in Ain El Zarqa and one in Sahl Machghara) which are highly demanding in terms of the electric power needed. Kredo has attempted to visit the Ain El Zarqa pumping station but found it locked and not operational. This main station has been constructed by the council for the south but has not been handed over to BWE yet. The auxiliary stations, such as Sahl Machghara (the coordinates of which are unknown at this point), will be executed by the CDR with the Kuweiti fund. Once operational the Ain El Zarqa system will provide water for a large number of localities in West Bekaa and Rachaiya as shown on the schematic. However the layout of the network connecting the pumping stations with the villages is not available.

Table 5-2 lists the 17 springs identified to date in the caza of West Bekaa as being used as a water source. The minimum, maximum, and average flows for these springs are listed along with the years for which recordings are available and the entity from which the data was collected. In some instances, these recordings consist of monthly measurements, while for others there are only sporadic measurements. For 11 of the springs, no information whatsoever is available to date regarding the water flow.

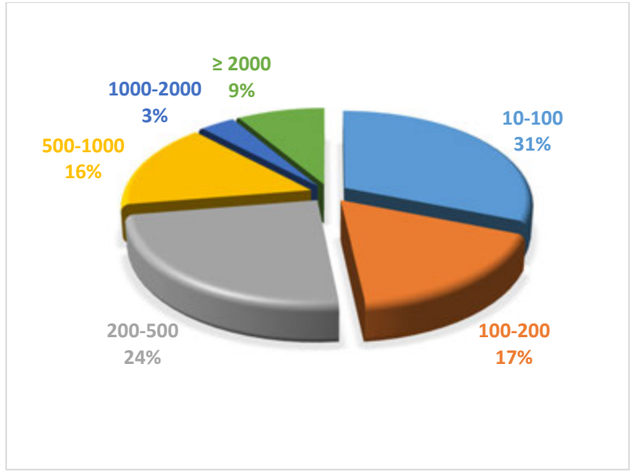


FIGURE 5-3: RESERVOIRS CAPACITY IN WEST BEKAA CAZA (IN M³)

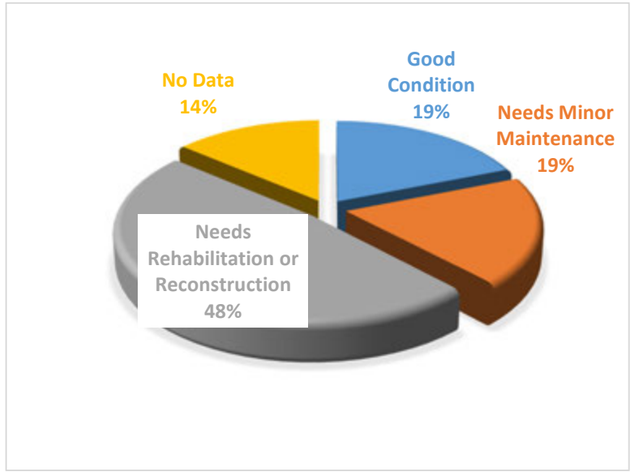


FIGURE 5-4: RESERVOIRS CONDITION IN WEST BEKAA CAZA

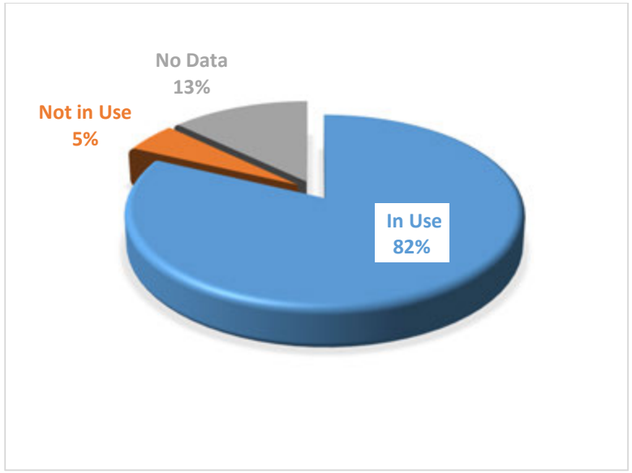


FIGURE 5-5: WELLS STATUS IN WEST BEKAA CAZA

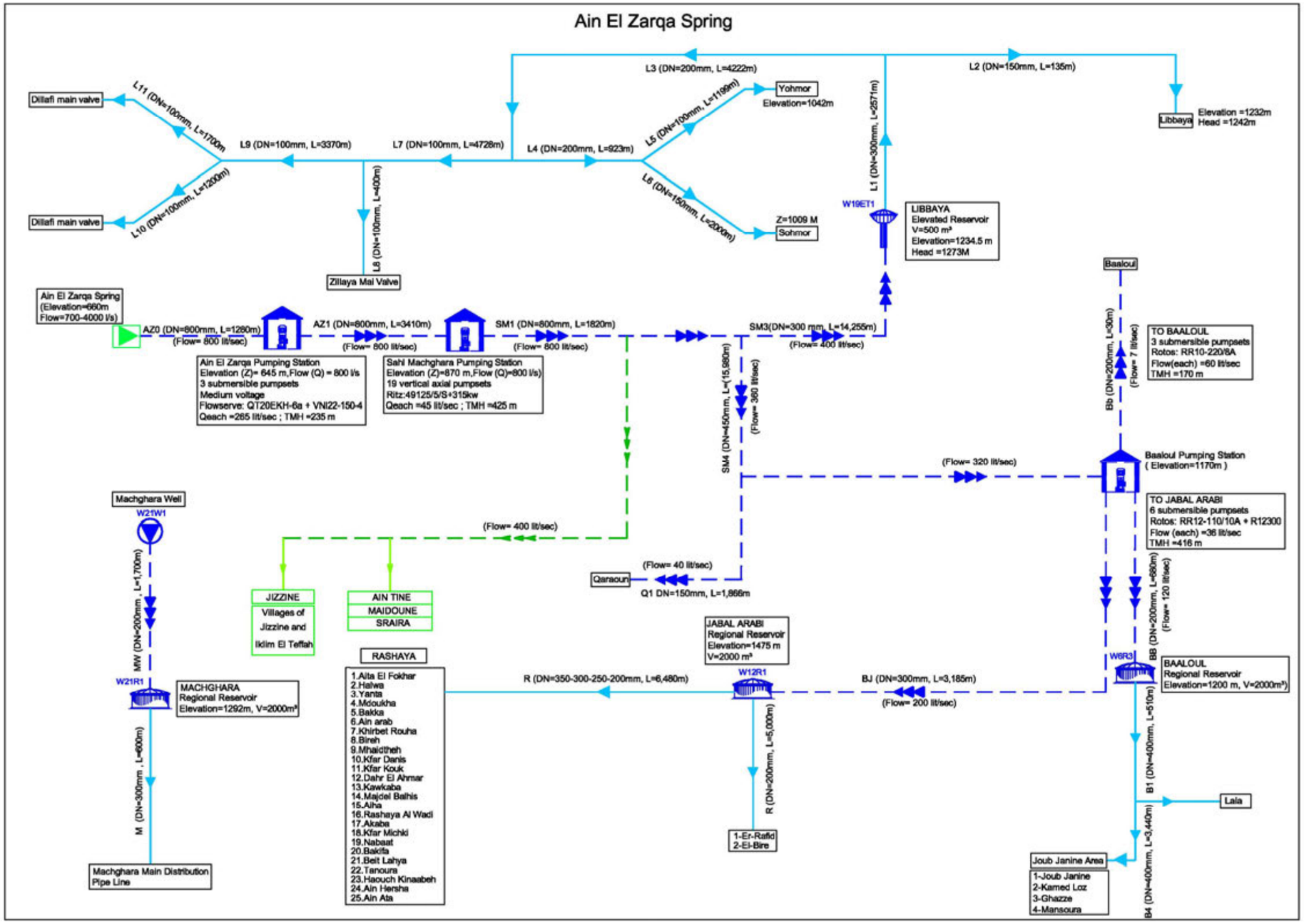
TABLE 5-2: SPRINGS IN WEST BEKAA CAZA

Casa	Spring name	Village	Code	Elevation	Min. Flow (l/s)	Max. Flow (l/s)	Avg. Flow (l/s)	Comments
West Bekaa	Aana (Aammiq)	Aammiq	W2S1	1186m	0	3,500	370	Not in use, based on BWE current data. LRA (2009-2011)
	Abou Fadayel		W17S1					Exact location unknown
	Abou Mikhayel		W17S3					Exact location unknown
	Ain El Naqair	Kefraiya	W15S2					
	Ain El Saiedeh	Bab Mareh	W7S2					
	Ain El Zarqa	Ain El Zarqa	W3S1	660m	700	4,000	2,065	Council of the south
					908	6,750	2,123	LRA (2009-2011)
	Ain Rmail		W28S1					Exact location unknown
	Ain Wadi El Jawz	Kefraiya	W15S1					
	Al Afiyeh		W17S2					Exact location unknown
	Khirbet Qanafar		W17S4					Exact location unknown
	Machgara (Ain El Abou Zaid)	Machghara	W21S1	1004m	25	156	78	Not in use, based on BWE current data. LRA (2009-2011)
	Machgara (Ain El Dayaa)	Machghara	W21S2	1019m	27	124	65	Not in use, based on BWE current data. LRA (2009-2011)
	Machgara (Ain El Knise - Said It El Niha)	Machghara	W21S3	1019m				Not in use, based on BWE current data
	Machgara (Ain El Tannour)	Machghara	W21S4	1012m	25	156	79	Not in use, based on BWE current data. LRA (2009-2011)
	Nabeh Al Assafir		W5S1					Exact location unknown
	Nabeh Beit Faraj		W5S2					Exact location unknown
	Rass El Nabeh	Bab Mareh	W7S1					

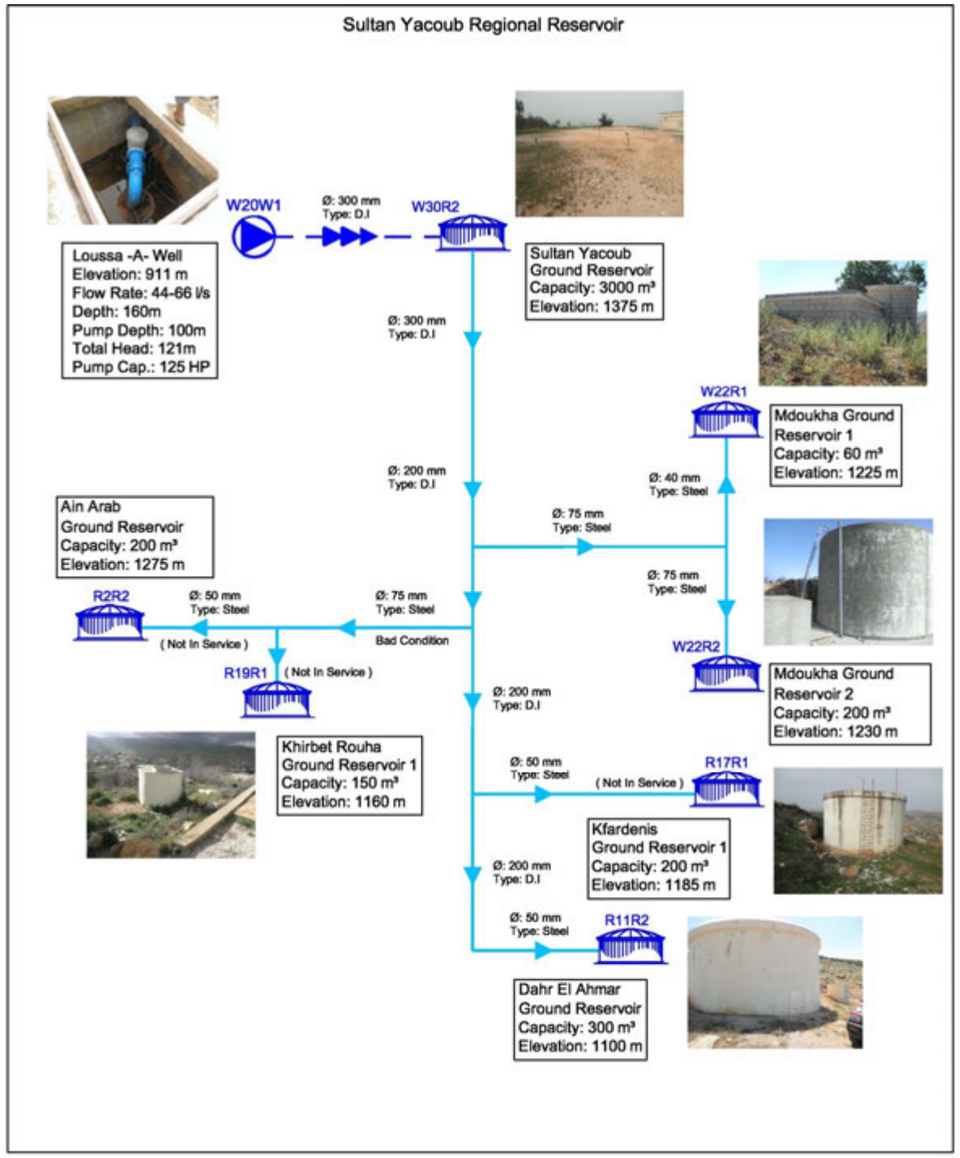
Legend:


LEGEND:
Gravity Pipe - Existing
Pressure Pipe - Existing
Pump Station - Existing
W.T.P
WTP
Well - Existing
Spring
Elevated Tank - Existing
Reservoir - Existing
CL
Chlorinator

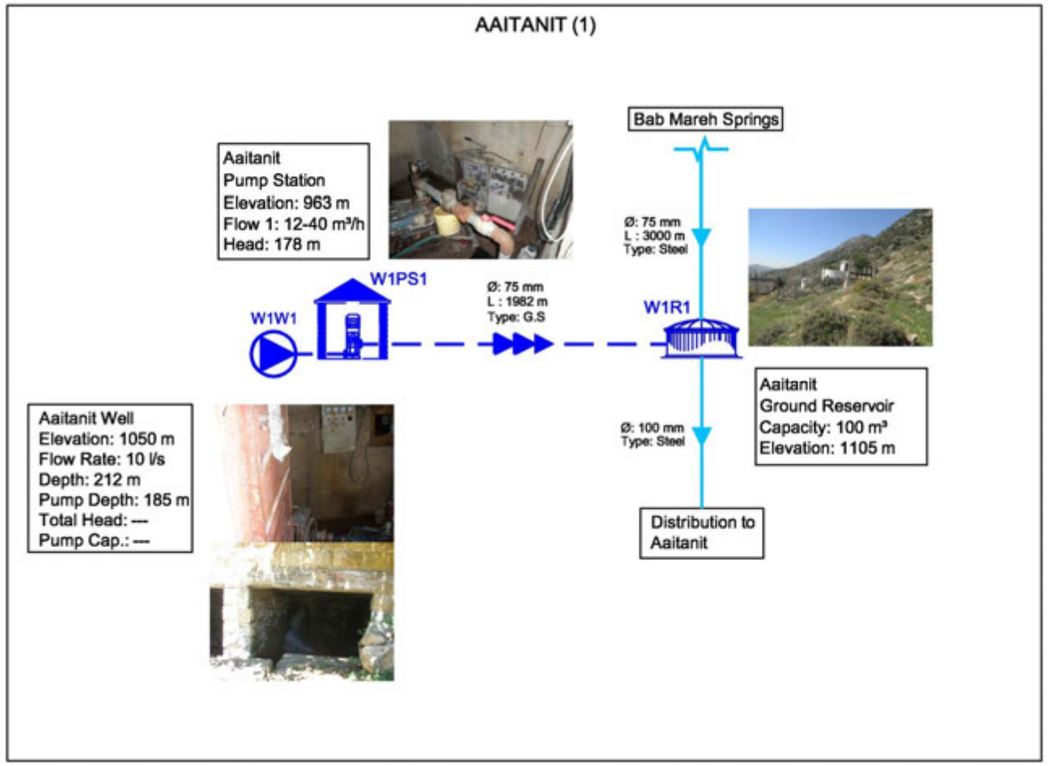
AIN EL ZARQA SPRING:



SULTAN YACOUB REGIONAL RESERVOIR:



Aaitanit (1)



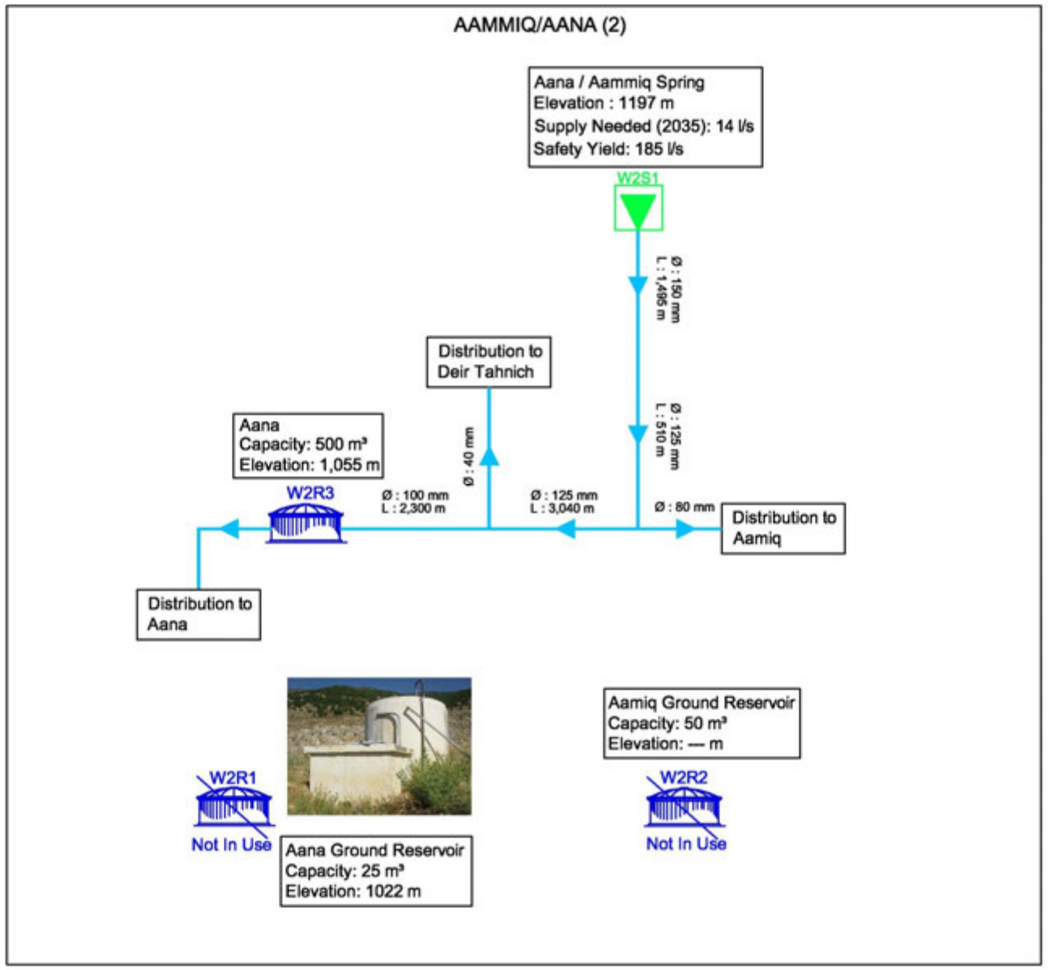
The existing water network is in very good condition and it has a length of around 5.5 km. It covers a part of the town. There is a proposed designed water network is still under construction.

Well W1W1: Well is very old and it is in bad condition. It needs rehabilitation

Pump station W1PS1: Pump station is very old. The pipes are rusted. This pump station needs rehabilitation.

Reservoir W1R1 (100 m^3): Reservoir is in good condition.

Aammiq/Aana (2)



The existing water network is in very good condition and it has a length of around 15 km. It covers a large area of the town.

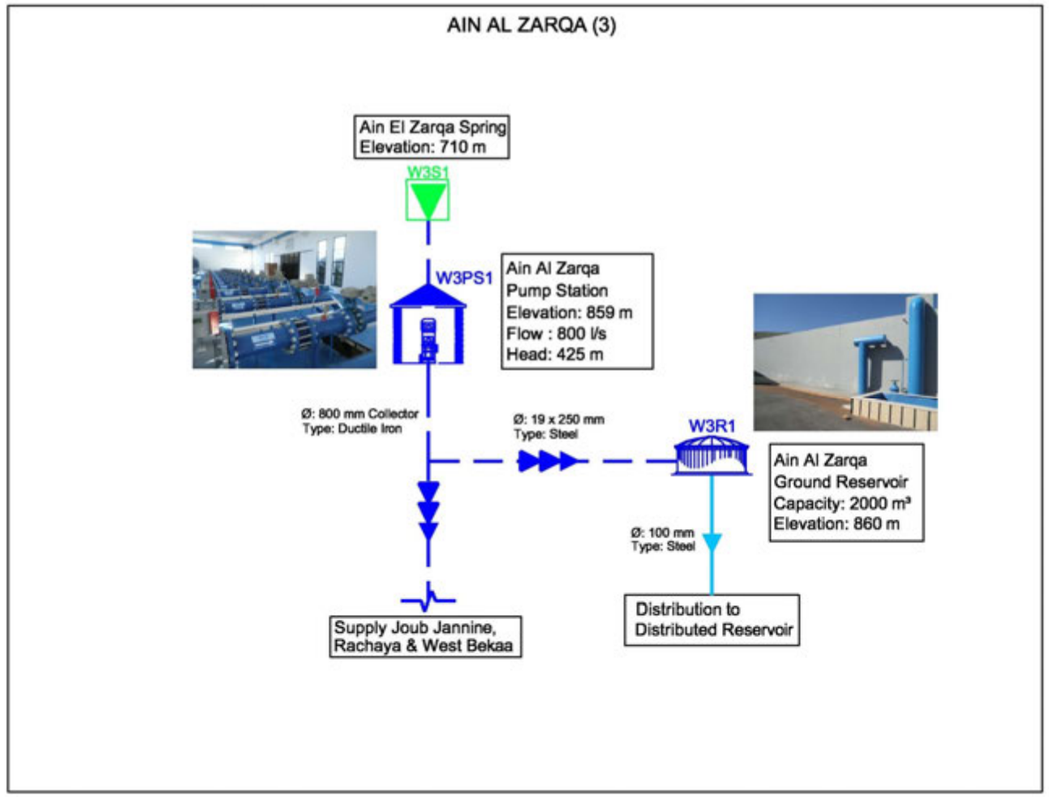
Spring W2S1: No available information.

Reservoir W2R1 (>30 years; 25 m^3): Reservoir is in acceptable condition. It is subjected to leakage. This reservoir needs esthetical rehabilitation and some maintenance. This reservoir is not in use anymore.

Reservoir W2R2 (50m^3): Reservoir is not in use.

Reservoir W2R3 (<2 years; 500 m^3): Reservoir is new and it is in good condition.

Ain Al Zarqa (3)



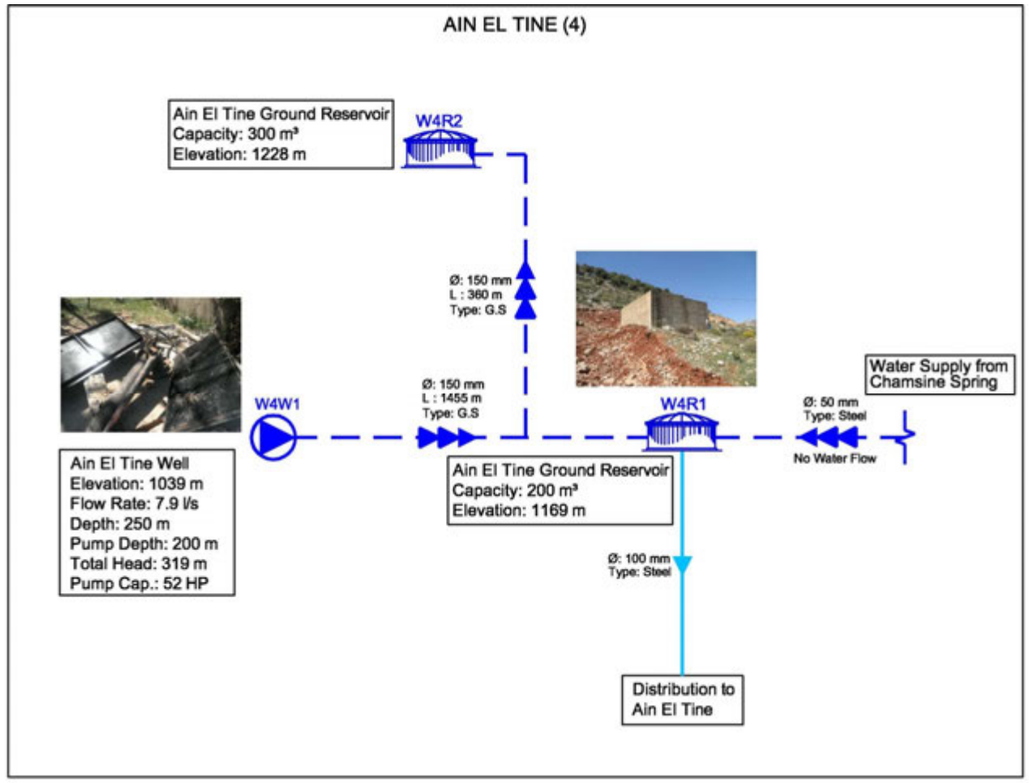
There is no available information concerning the water network of the town.

Spring W3S1: The estimated safety yield adopted is about 1321 l/s.

Pump station W3PS1: Pump station is in good condition and it is made of 10 pumps. Pumps are still not functioning.

Reservoir W3R1 (5 years old; 2000 m^3): Reservoir is in good condition. It is subjected to leakage. This reservoir needs esthetical rehabilitation.

Ain El Tine (4)



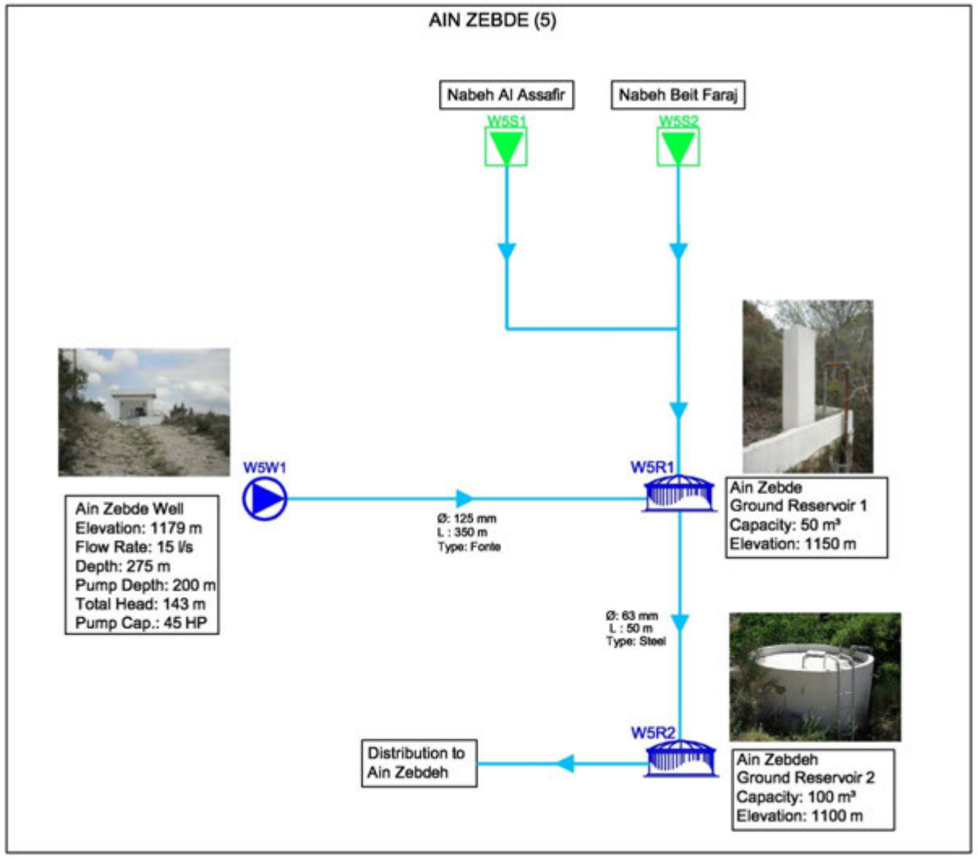
There is no available information concerning the water network of the town. A new line coming from Ain El Zarqa spring will supply this village once system becomes operational. The specific layout could not be obtained.

Well W4W1 (30 years old): Well is in acceptable condition. There is chlorination unit but it is not functioning. The access key of the building was lost during time of visit. There is no power generation.

Reservoir W4R1 (>30 years; 200 m³): Reservoir is in acceptable condition. It doesn't have an overflow pipe. This reservoir needs esthetical rehabilitation and some maintenance.

Reservoir W4R2 (< 2 years; 300 m³): Reservoir is new and it is in good condition.

Ain Zebde (5)



The existing water network is in very good condition and it has a length of around 10 km. It covers a large area of the town.

Well W5W1 (15 years old): Well is in acceptable condition and it suffers from a shortage of electric power. A chlorine dozing pump is found; however, it is not working.

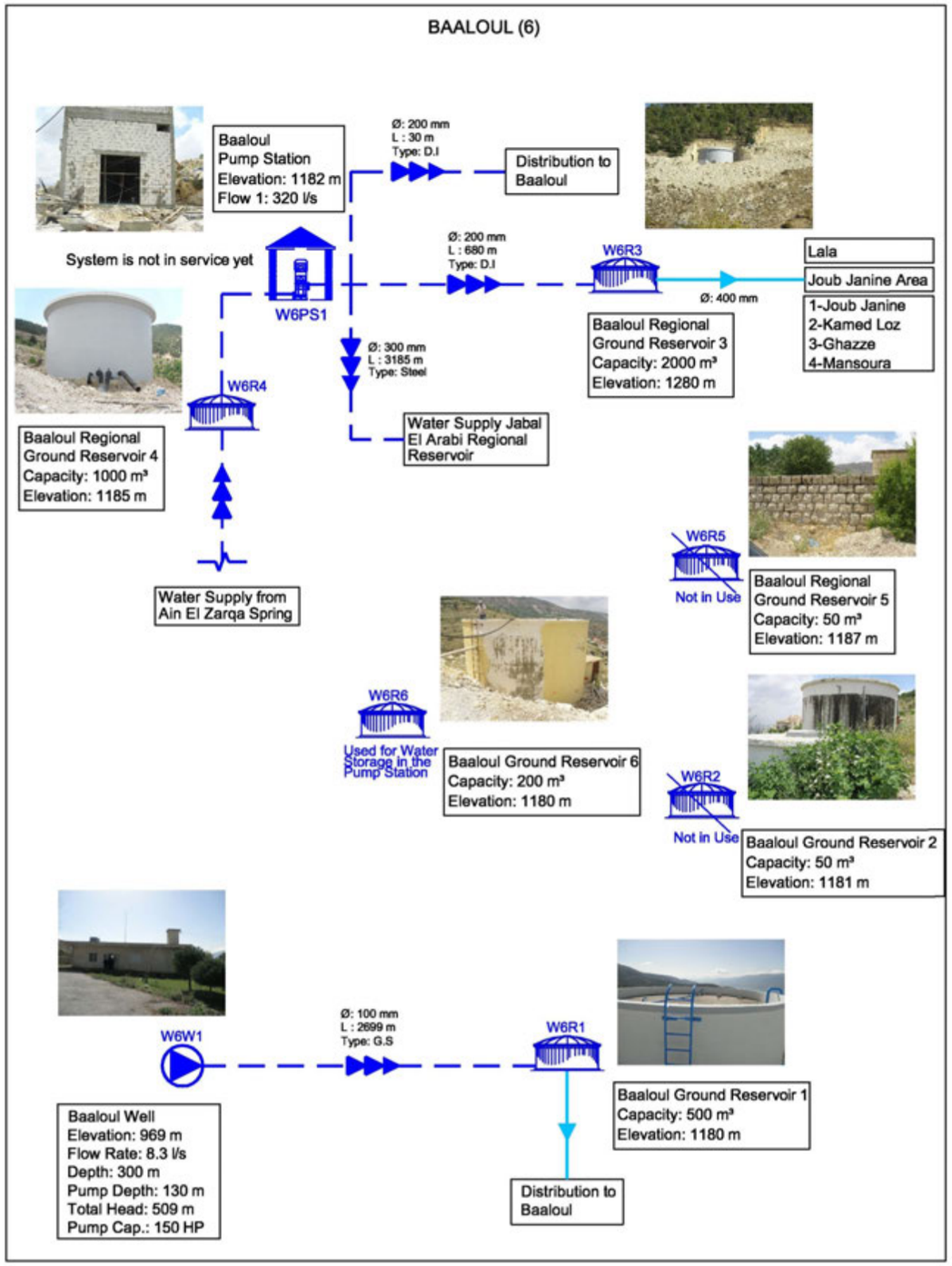
Spring W5S1: Spring dries in summer season.

Spring W5S2: Spring dries in summer season.

Reservoir W5R1 (>60 years; 50 m³): Reservoir is in acceptable condition. It doesn't have an overflow pipe and excess water flooded the roof of the reservoir. It needs some minor maintenance.

Reservoir W5R2 (100 m³): Reservoir is in acceptable condition. It needs esthetical rehabilitation and some maintenance.

Baaloul (6)



There is no available information concerning the water network of the town.

Well W6W1 (30 years old): Well is in acceptable condition. No more available information.

Pump station W6PS1: Pump station was built 5 years ago and it still not operational yet.

Reservoir W6R1 (500 m^3): Reservoir is in good condition. It doesn't have neither flow meters nor bypass. It needs some minor maintenance.

Reservoir W6R2 (50 m^3): Reservoir is very old and not in use. It needs reconstruction.

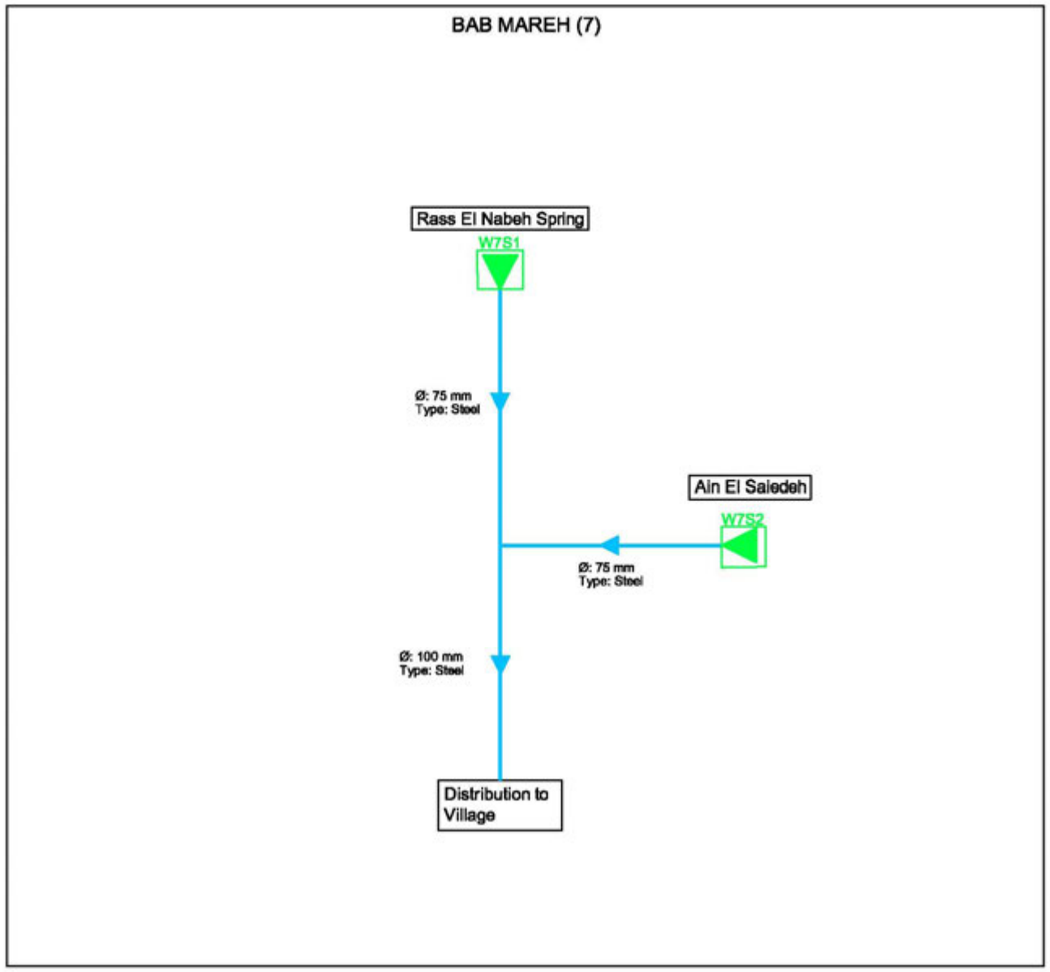
Reservoir W6R3 (2000 m^3): Reservoir is new and it is in good condition. It is a regional reservoir for Ain El Zarqa system.

Reservoir W6R4 (>15 years; 1000 m^3): Reservoir is new and it is in good condition. It is located near the pump station. It is a storage reservoir for Ain El Zarqa system.

Reservoir W6R5 (50 m^3): Reservoir is very old and it is not in use.

Reservoir W6R6 (200 m^3): Reservoir is old and it is in bad condition. It is used for water storage only. It needs rehabilitation.

Bab Mareh (7)

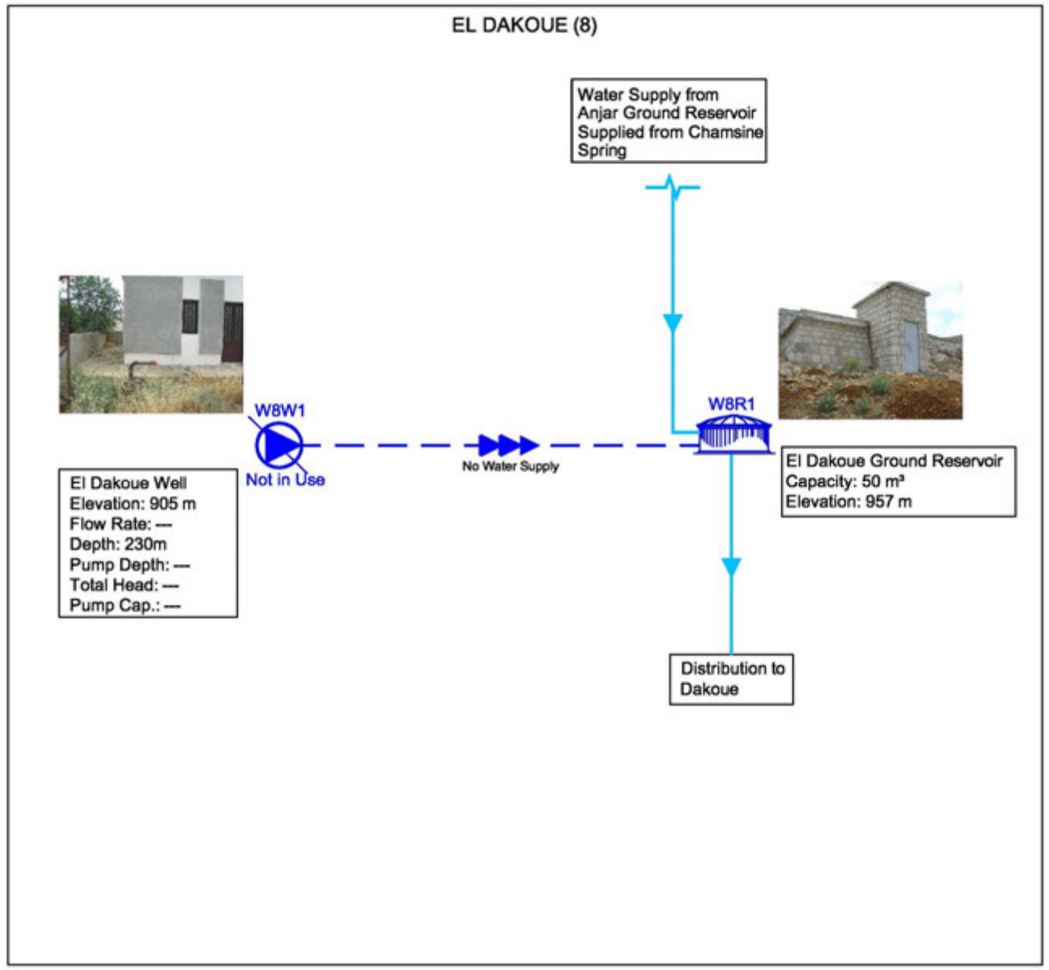


The existing water network is in good condition and it has a length of around 0.6 km. It covers a small area of the town.

Spring W7S1: No available information.

Spring W7S2: No available information.

Dakoue (8)

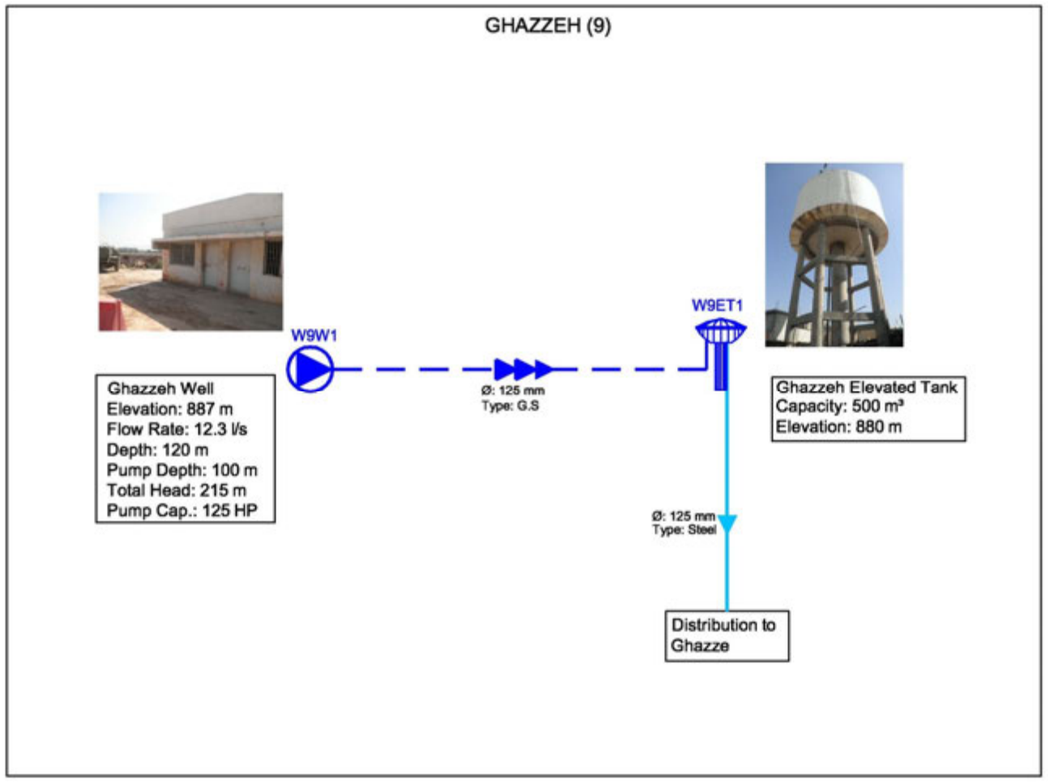


The existing water network is in very good condition and it has a length of around 9 km. It covers a large area of the town.

Well W8W1: Well is not in use yet due to problems regarding the alignment of its transmission pipe. There is no water outlet pipe.

Reservoir W8R1 (50 m^3): Reservoir is very old and it is in bad condition. It is subjected to leakage. This reservoir needs esthetical rehabilitation and some maintenance.

Ghazzeh (9)

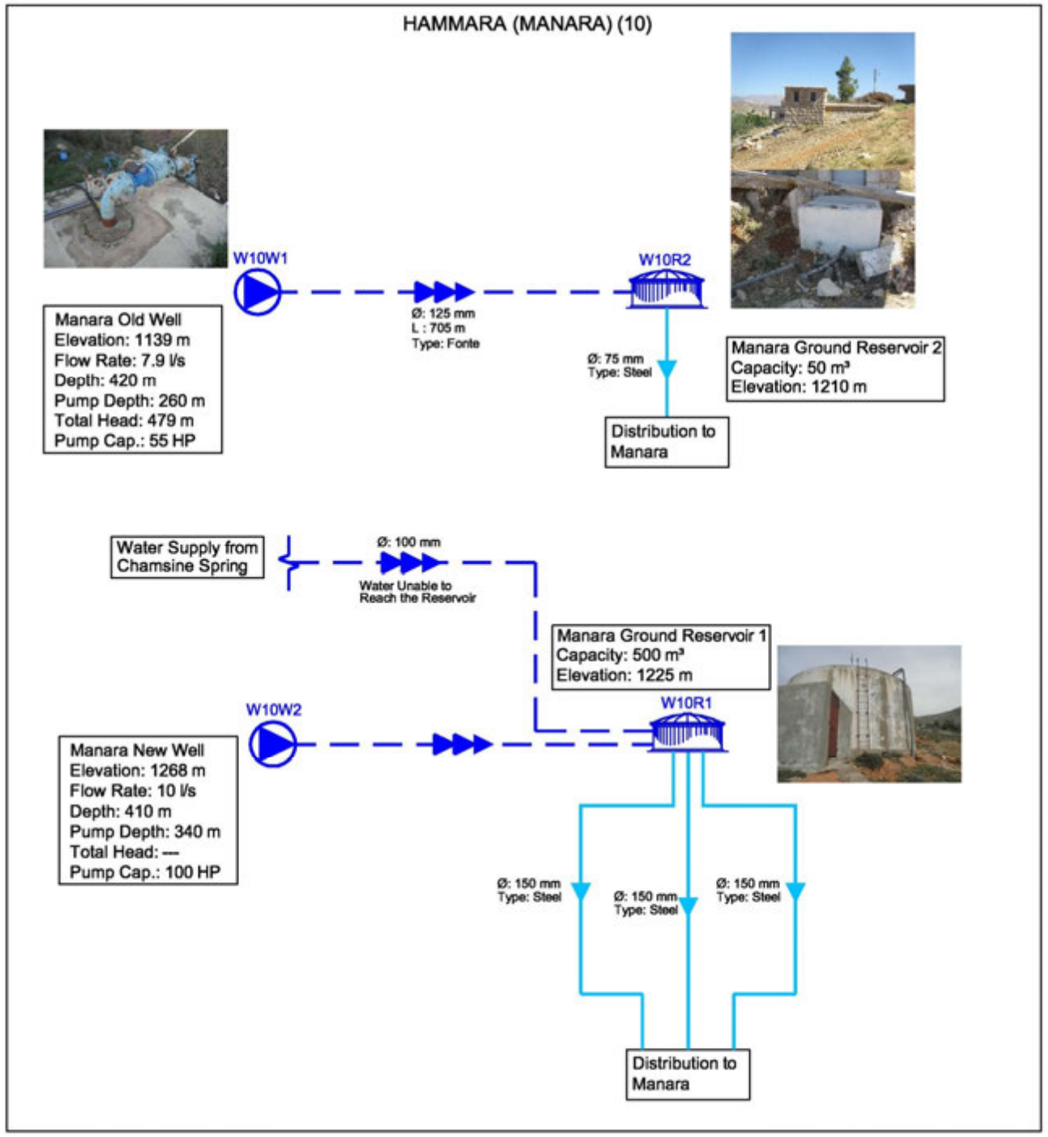


The existing water network is in very good condition and it has a length of around 32 km. It covers a large area of the town. A new line coming from Baaloul regional reservoir will supply this village once Ain El Zarqa system becomes operational. The specific layout could not be obtained.

Well W9W1 (<45 years): Well is old but it is in acceptable condition. It suffers from a shortage of electric power. There is no chlorination unit. Its pipes are rusted and need to be changed. This well needs rehabilitation (building, equipment…)

Elevated tank W9ET1 (500 m3): Elevated tank is old but it is in acceptable condition. It needs esthetical rehabilitation.

Hammara (Manara) (10)



The existing water network is in very good condition and it has a length of around 28 km. It covers a large area of the town.

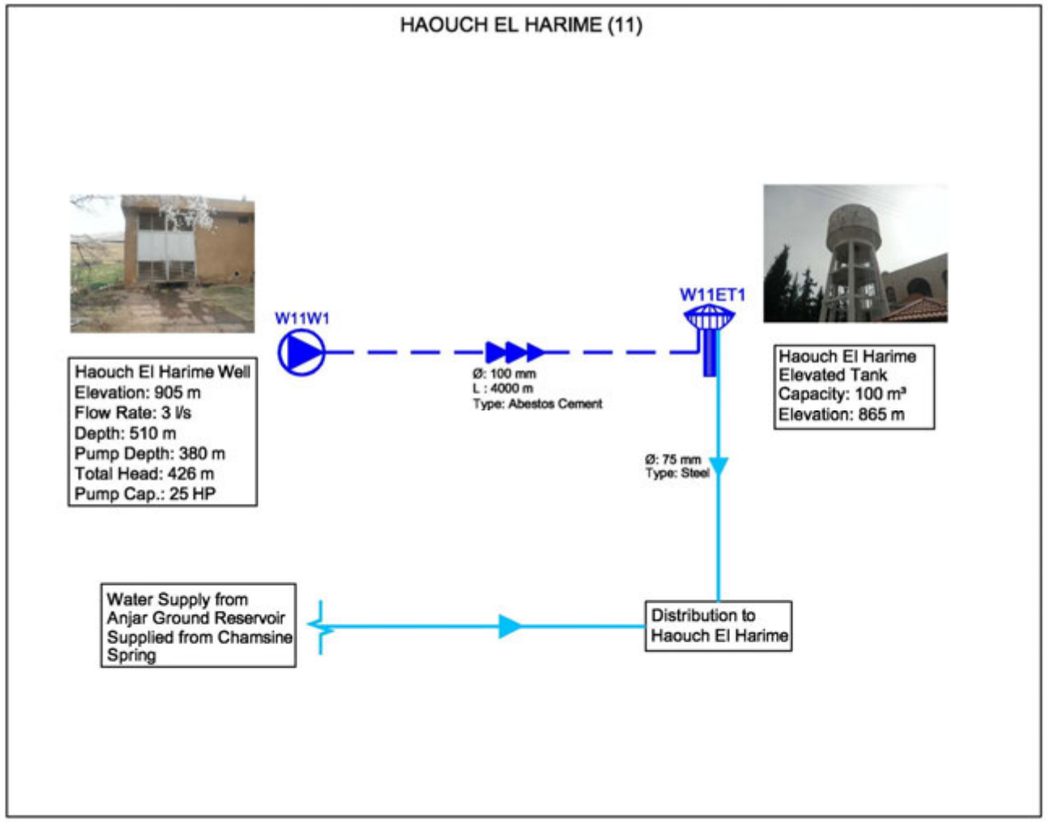
Well W10W1 (>15 years): Well is in acceptable condition.

Well W10W2 (5 years old): Well is new but it suffers from a shortage of electric power. No more available information.

Reservoir W10R1 (>15 years; 500 m^3): Reservoir is old but it is in acceptable condition. Some of its pipes are rusted. It needs minor maintenance and esthetical rehabilitation.

Reservoir W10R2 (50 m^3): Reservoir is very old. The pipes in the valve chamber are broken. This reservoir needs rehabilitation or reconstruction.

Haouch El Harime (11)

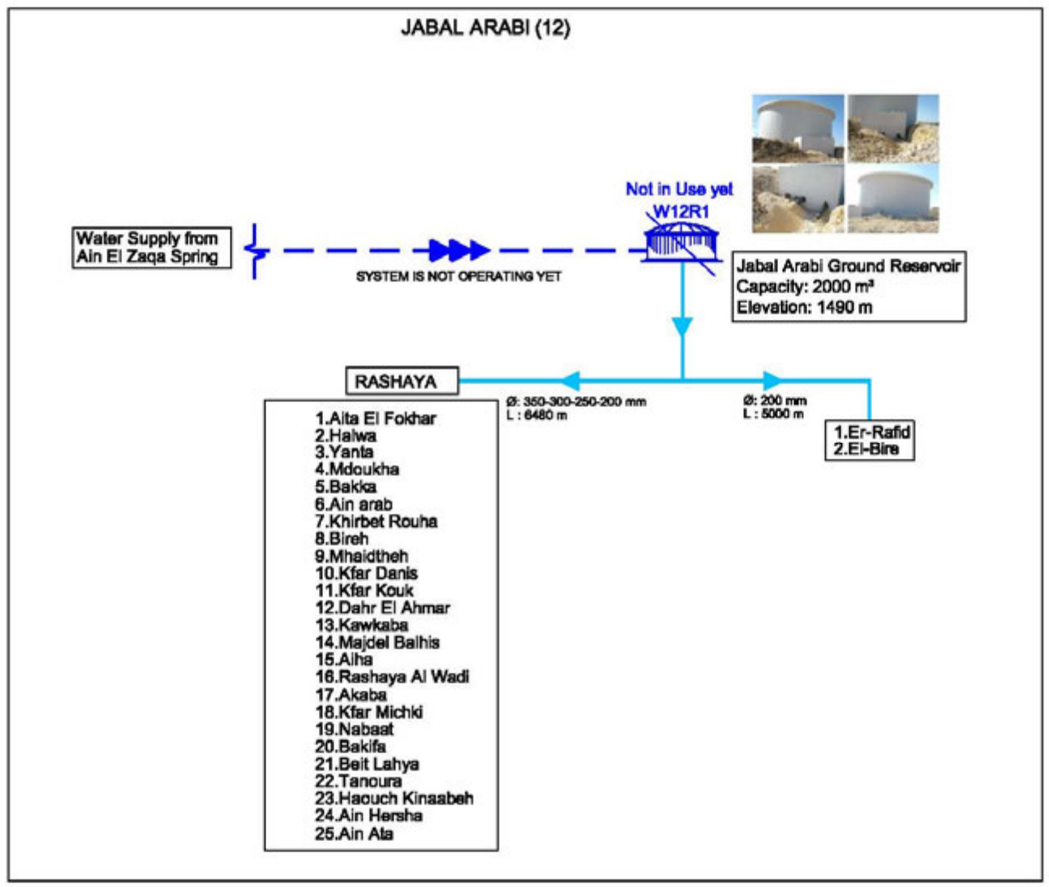


The existing water network is in very good condition and it has a length of around 24 km. It covers a large area of the town.

Well W11W1 (25 years old): Well is old and it is in bad condition. The chlorination units and the power generation are not working. Its pipes are rusted and they are subjected to leakage. There is no available information concerning the pump. This well needs rehabilitation.

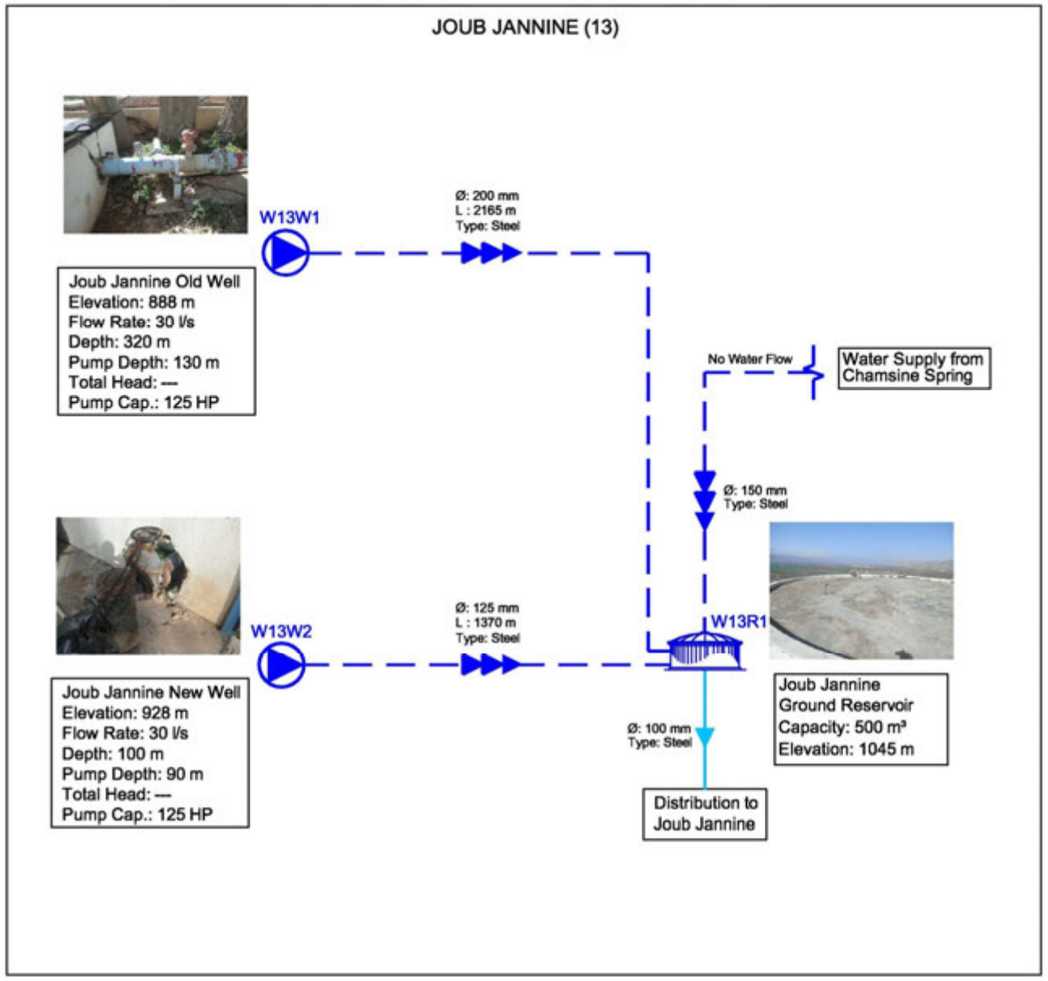
Elevated tank W11ET1 (>30 years; 100 m³): Elevated tank is old but it is in good condition. It is not subjected to leakage. The valve chamber of this tank is inaccessible. This elevated tank needs some minor maintenance.

Jabal Arabi (12)



Reservoir W12R1 (2000 m³): Reservoir is new and it is in good condition but it is not in use yet.

Joub Jannine (13)



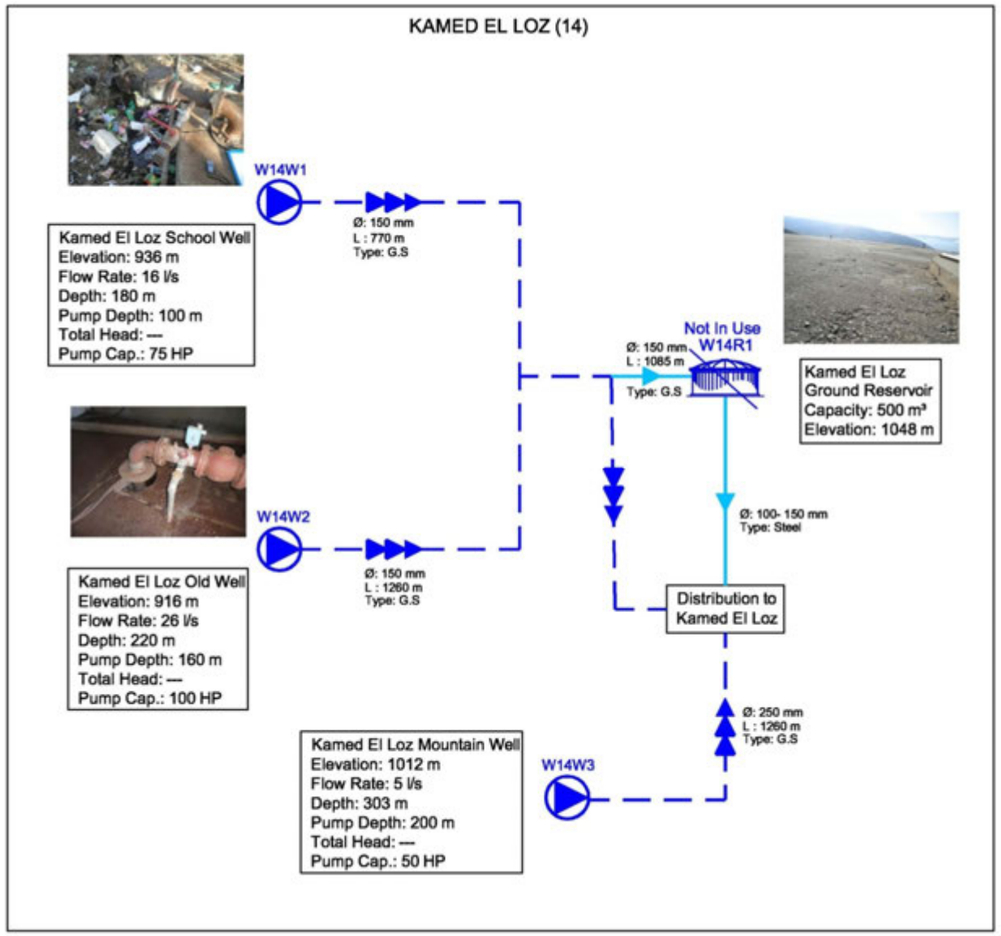
The existing water network is in very good condition and it has a length of around 46 km. It covers a large area of the town. A new line coming from Baaloul regional reservoir will supply this village once Ain El Zarqa system becomes operational. The specific layout could not be obtained.

Well W13W1 (<35 years): Well is in acceptable condition. The chlorination is not working and the pump is subjected to leakage. It needs some minor maintenance.

Well W13W2 (15 years old): Well is in good condition. There is no chlorination unit. Some steel pipes are rusted. This well needs some minor maintenance.

Reservoir W13R1 (500 m^3): Reservoir is in good condition. Its roof is subjected to cracks and it needs rehabilitation.

Kamed El Loz (14)



The existing water network is in very good condition and it has a length of around 35 km. It covers a large area of the town. A new line coming from Baaloul regional reservoir will supply this village once Ain El Zarqa system becomes operational. The specific layout could not be obtained.

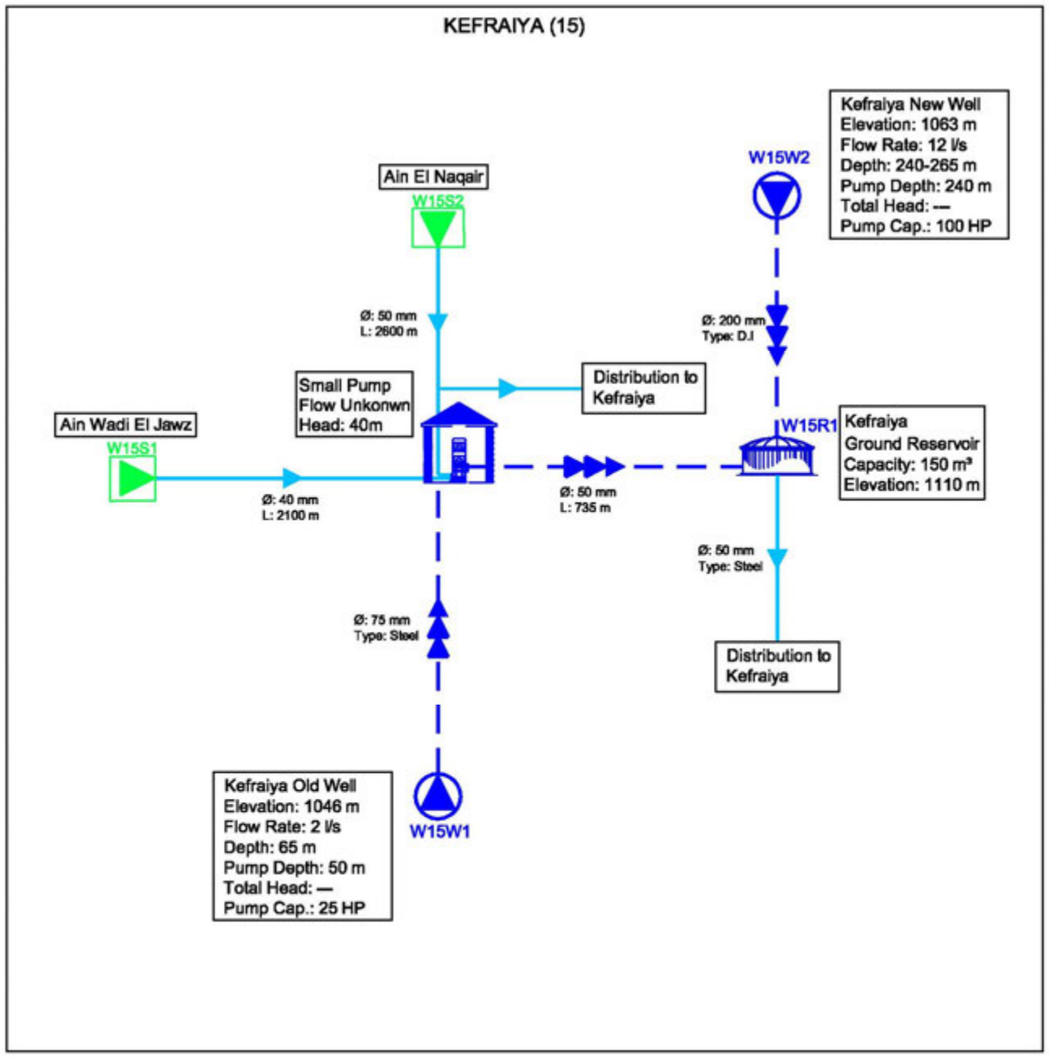
Well W14W1 (15 years old): Well is in bad condition. Its valve chamber doesn't have a concrete cover and it is full of rubbish. Well building is in very bad condition and it is dirty. The pipes are rusted. This well needs rehabilitation.

Well W14W2 (45 years old): This well was constructed in year 1970. It is in acceptable condition. Its pipes are rusted and the chlorination unit is not working. A fence shall be installed around the well borehole. Rubbish shall be cleaned near well borehole.

Well W14W3 (<5 years): Well is new and it is in good condition.

Reservoir W14R1 (20 years old; 500 m^3): Reservoir is in acceptable condition but it is not in use. Its valves and pipes need to be changed because they are rusted and subjected to leakage. This reservoir shall be cleaned from dead lizards.

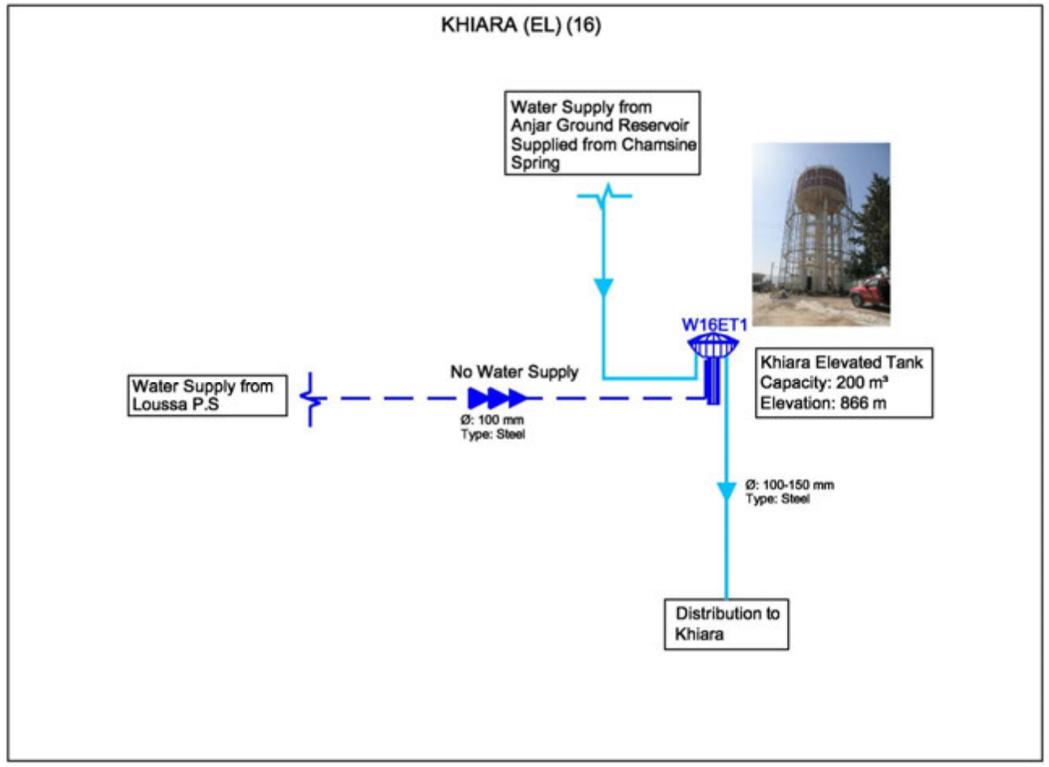
Kefraiya (15)



The existing water network is in very good condition and it has a length of around 21 km. It covers a large area of the town

Well W15W1 (35 years old), Well W15W2 (15 years old), Spring W15S1, Spring W15S2, Reservoir W15R1 (150 m^3), Small pump: No available information

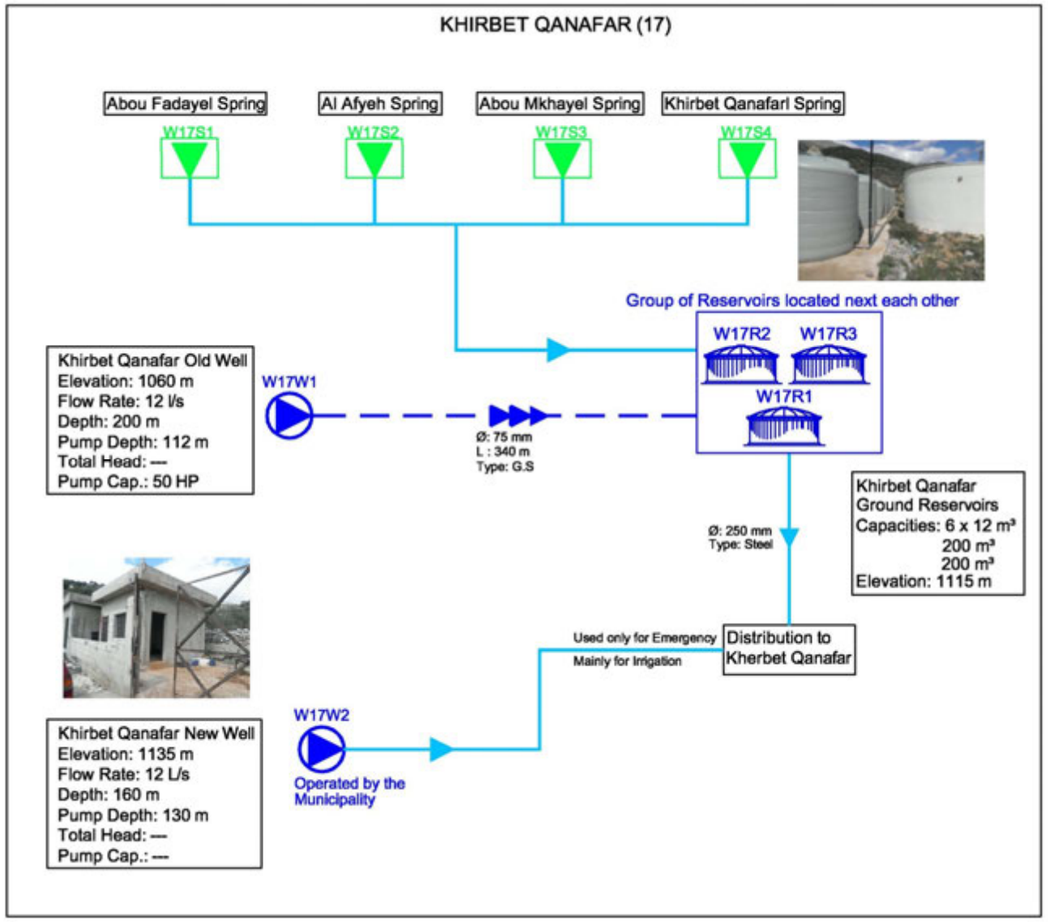
Khiara (El) (16)



The existing water network is in very good condition and it has a length of around 9 km. It covers a large area of the town

Elevated tank W16ET1 (20 years old; 200 m3): Elevated tank is in good condition. Access was unavailable to valve chamber. It was under rehabilitation during visit time

Khirbet qanafar (17)



The existing water network (installed in year 2003) is in good condition.

Well W17W1 (45 years old): Well is in acceptable condition. Chlorination unit is available but it is not in use. No more available information.

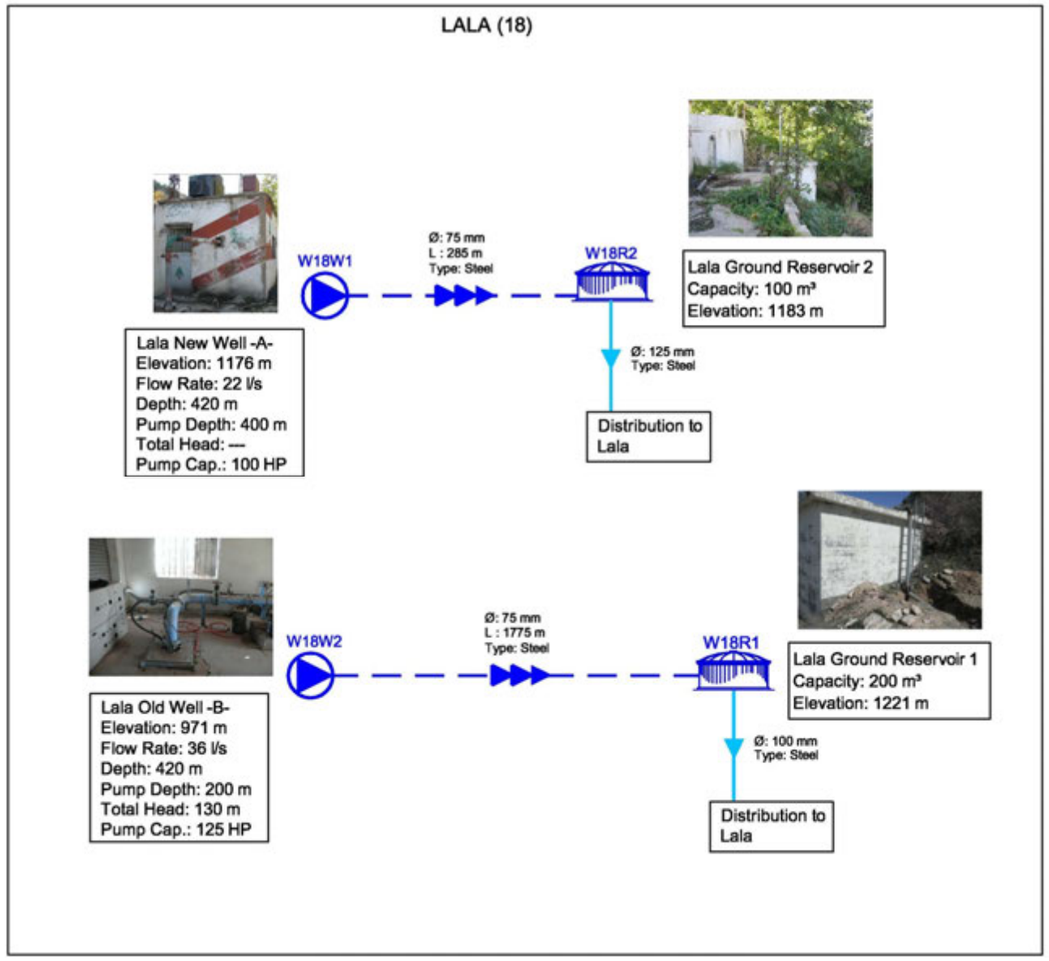
Well W17W2 (5 years old): Well is new but it was not operated by the BWE. The pump is locked inside the well. This well has a new generator and chlorination unit.

Spring W17S1, W17S2, W17S3 and W17S4: No available information.

Reservoir W17R1 (200 m³), W17R2 (6x12m³) & W17R3 (200 m³): Reservoirs are in good condition.

W17R2 are group of six plastic reservoirs and they were added in 2006.

Lala (18)



There is no available information concerning the water network of the town. The main pipe between well and reservoir is updated. A new line coming from Baaloul regional reservoir will supply this village once Ain El Zarqa system becomes operational. The specific layout could not be obtained.

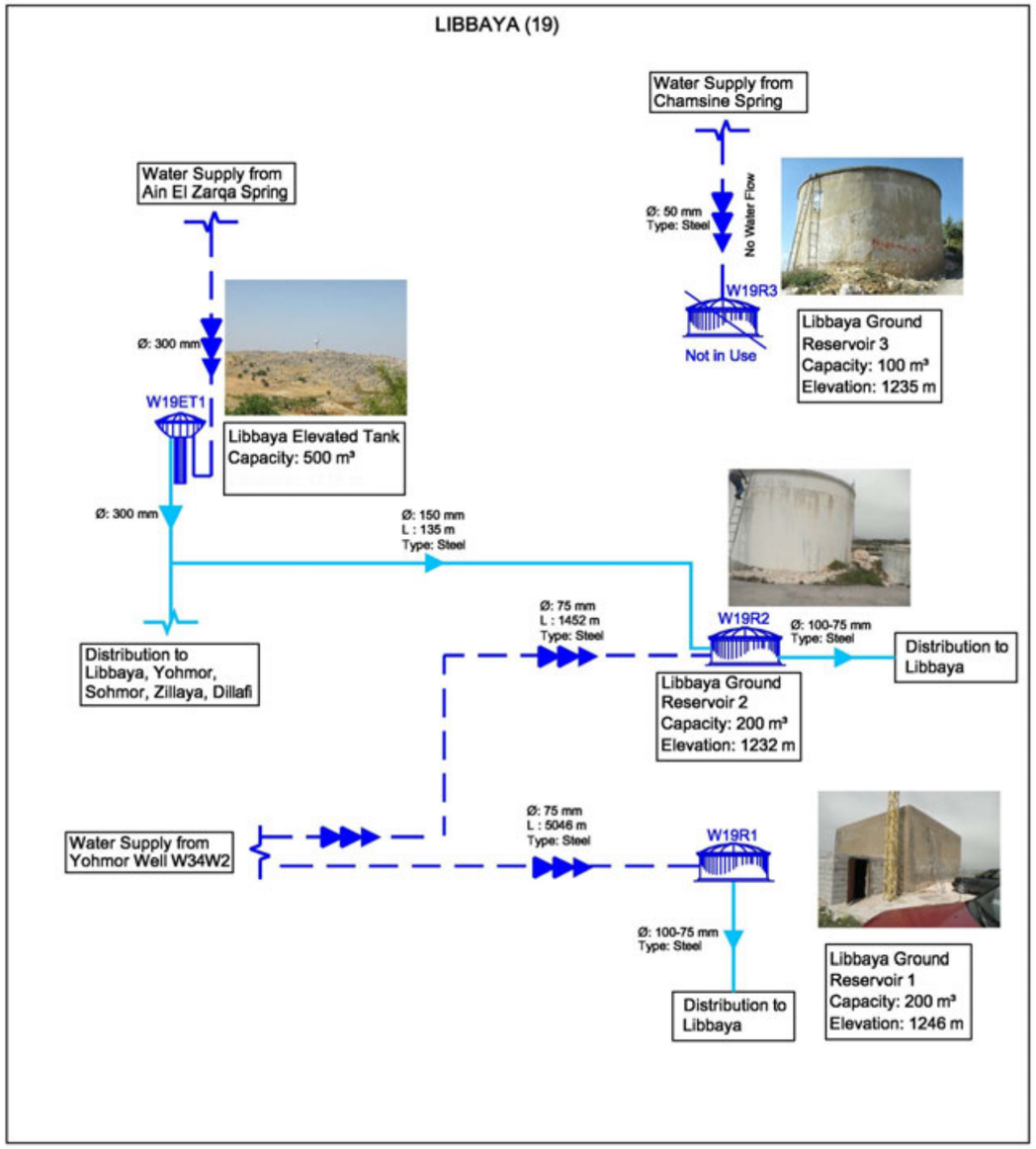
Well W18W1 (25 years old): Well is old and it is in bad condition. It needs rehabilitation.

Well W18W2 (>45 years): Well is old and it is in acceptable condition. Chlorination system is found (tanks + pumps) but it is not incorporated into system.

Reservoir W18R1 (>15 years; 200 m³): Reservoir is old but it is in acceptable condition. It needs esthetical rehabilitation.

Reservoir W18R2 (100 m³): Reservoir is old. No more available information.

Libbaya (19)



There are old and new water networks (installed in years 1975 and 2005 respectively) in the town and they are connected together. The old network is in acceptable condition.

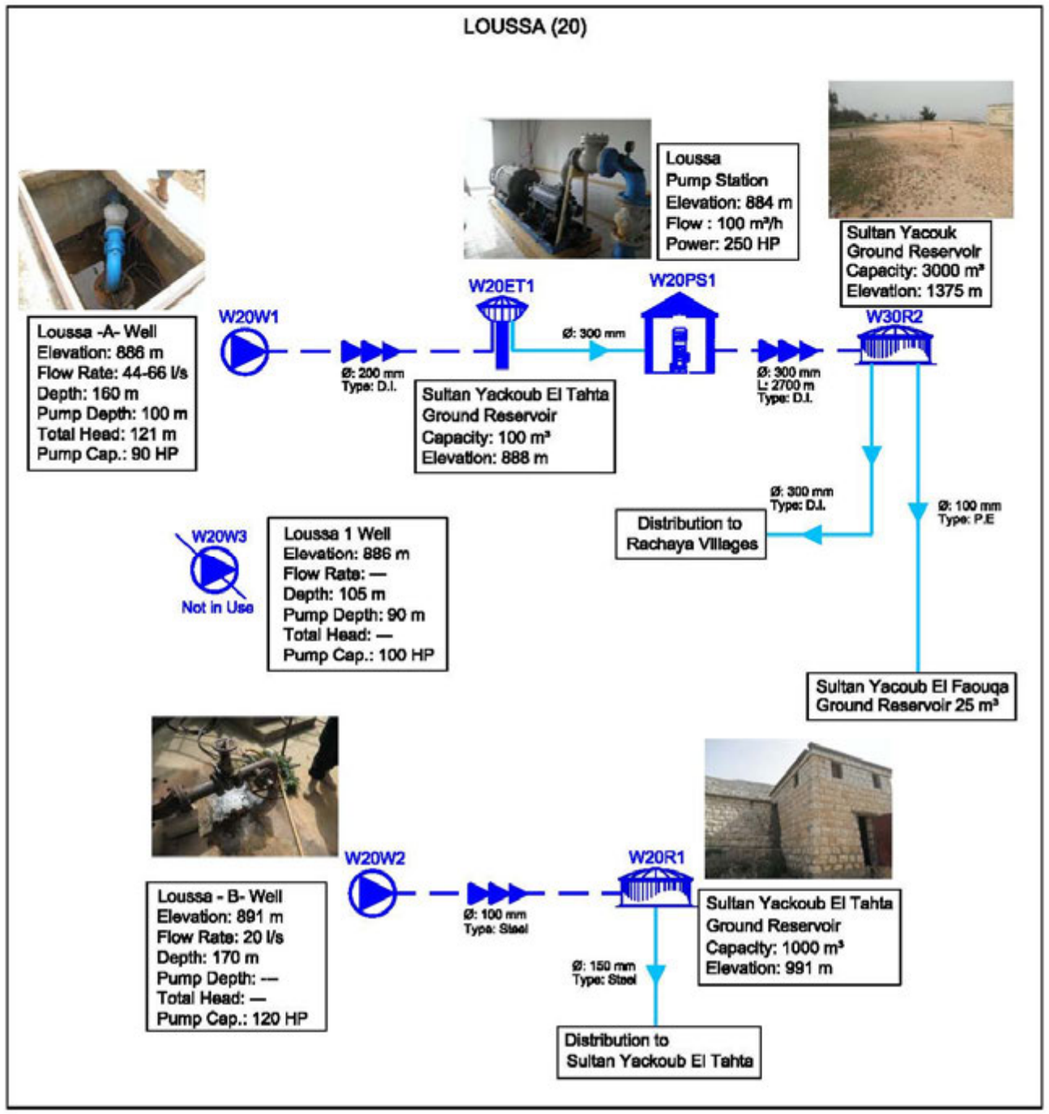
Reservoir W19R1 (>20 years; 200 m³): Reservoir is old and it is in bad condition. Pipes and valves are rusted and they need to be changed. This reservoir needs structural and esthetical rehabilitations or reconstruction.

Reservoir W19R2 (>20 years; 200 m³): Reservoir is old but it is in acceptable condition. It needs some maintenance.

Reservoir W19R3 (100 m³): Reservoir is destroyed.

Elevated tank W19ET1 (500 m3): Elevated tank is new but it is still not in use. It is a part of Ain El Zarqa water system.

Loussa (20)



There is no available information concerning the water network of the town.

Well W20W1 (15 years old): Well is new and it is in good condition.

Well W20W2 (15 years old): Well is old but it is in acceptable condition. There is no chlorination unit and the power generator is broken. This well needs some minor maintenance.

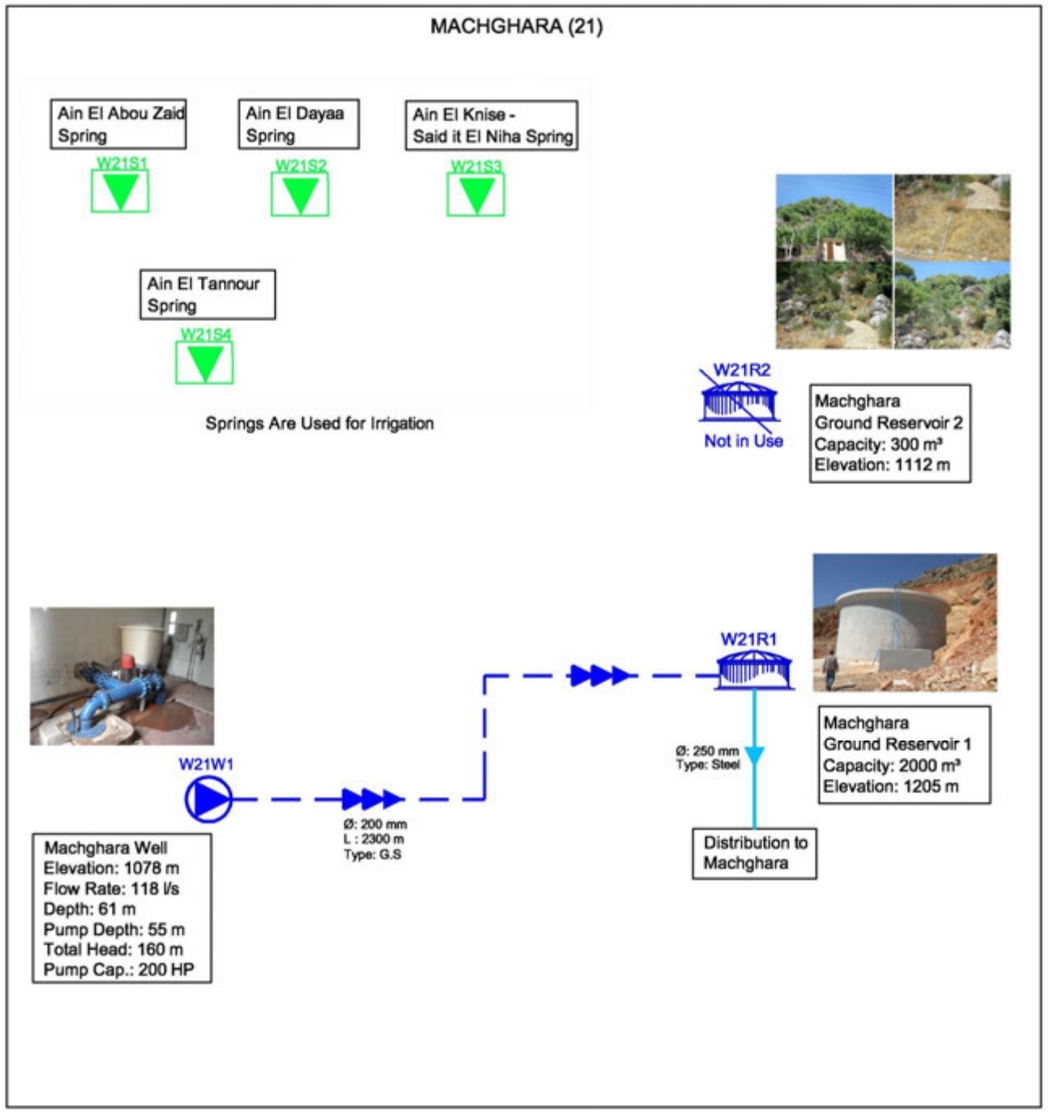
Well W20W3 (25 years old): Well is not in use.

Pump station W20PS1: Pump station is in good condition.

Elevated tank W20ET1 (65 years old; 100 m^3): Elevated tank is in good condition.

Reservoir W20R1 (1000 m^3): Reservoir is old but it is in acceptable condition. It needs some minor maintenance.

Machghara (21)



The existing water network is in good condition and it has a length of around 24 km. It covers a large area of the town

Well W21W1 (35 years old): Well is in acceptable condition but it suffers from a shortage of electric power and building needs repair and painting. Also the chlorination is disconnected while installing a new pump and it still not reconnected. This pump is for two reservoirs but not connected to the electrical generator Scania 230 kva. This well building needs rehabilitation.

Spring W21S1: This spring is used by a restaurant. There are some private gravity pipes connected to this spring. It is used mainly for irritation.

Spring W21S2: No available information.

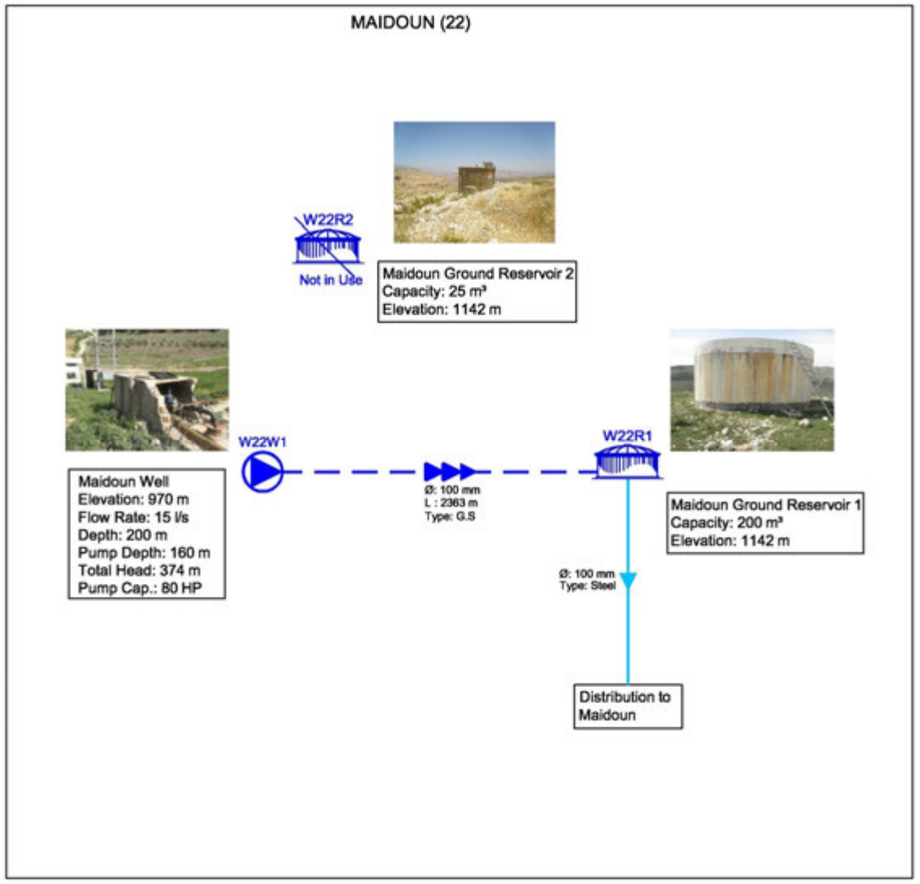
Spring W21S3: Few private gravity pipes are connected to this spring. No more available information.

Spring W21S4: There are some private gravity pipes connected to this spring. It is used mainly for irritation.

Reservoir W21R1 (>5 years; 2000 m^3): Reservoir is in good condition but it needs an esthetical rehabilitation. Also, the valve chamber is flooded with water; it needs sump or drainage pipe.

Reservoir W21R2 (300 m^3): Reservoir is not in use.

Maidoun (22)



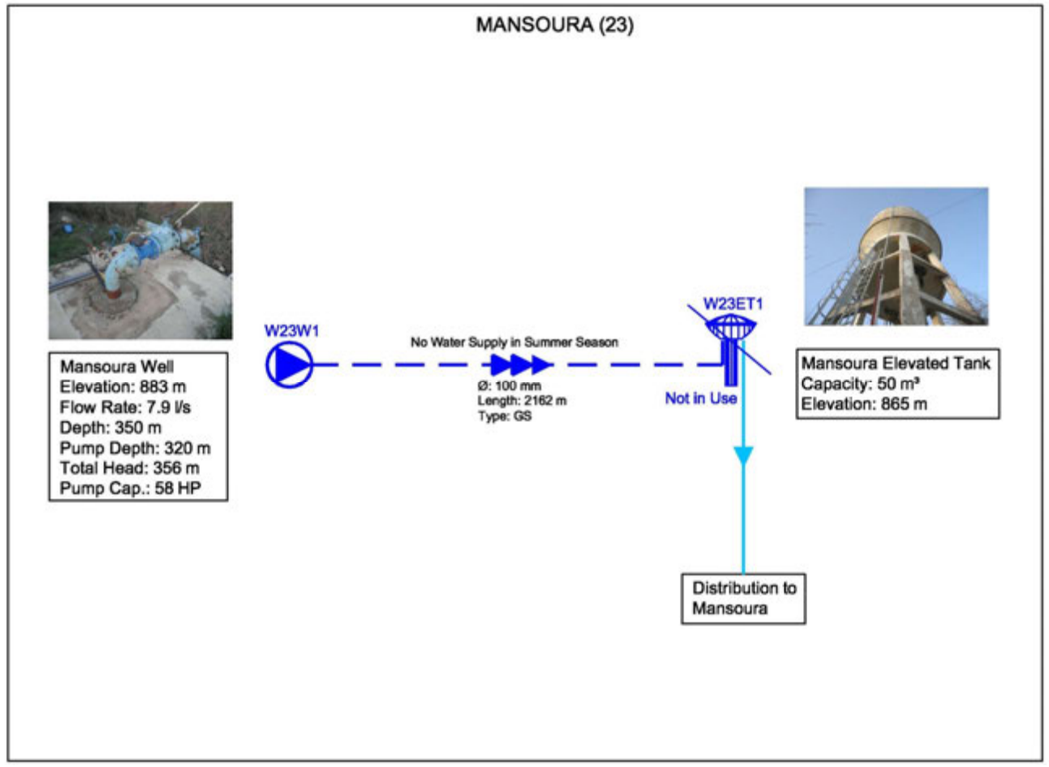
There is no available information concerning the water network of the town. A new line coming from Ain El Zarqa spring will supply this village once system becomes operational. The specific layout could not be obtained.

Well W22W1 (30 years old): Well is old but it is in acceptable condition. There is no direct water outlet and the chlorination unit is new but still not functioning. The well concrete chamber is broken and need to be reconstructed.

Reservoir W22R1 (>10 years; 200 m³): Reservoir is in acceptable condition but it is subjected to leakage. Some valves need to be changed. This reservoir needs some maintenance and esthetical rehabilitation.

Reservoir W22R2 (25 m³): Reservoir is very old and it is not used for supplying domestic water. It needs rehabilitation or reconstruction.

Mansoura (23)

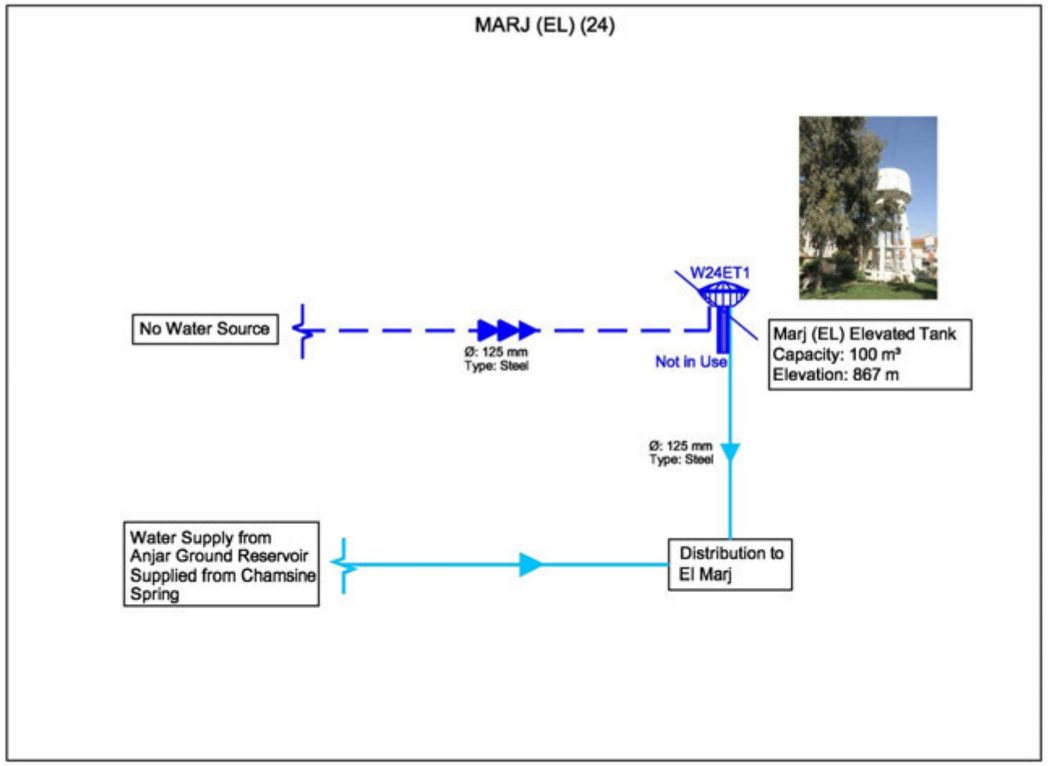


The existing water network is in very good condition and it has a length of around 10.5 km. It covers a large area of the town. A new line coming from Baaloul regional reservoir will supply this village once Ain El Zarqa system becomes operational. The specific layout could not be obtained.

Well W23W1 (>10 years): Well is in acceptable condition but it suffers from a shortage of electric power. It has a generator. This well borehole shall be secured by a fence.

Elevated tank W23ET1 (60 years old; 50 m³): Elevated tank is old and it is not in use. Water is directly connected to the network. This elevated tank needs rehabilitation.

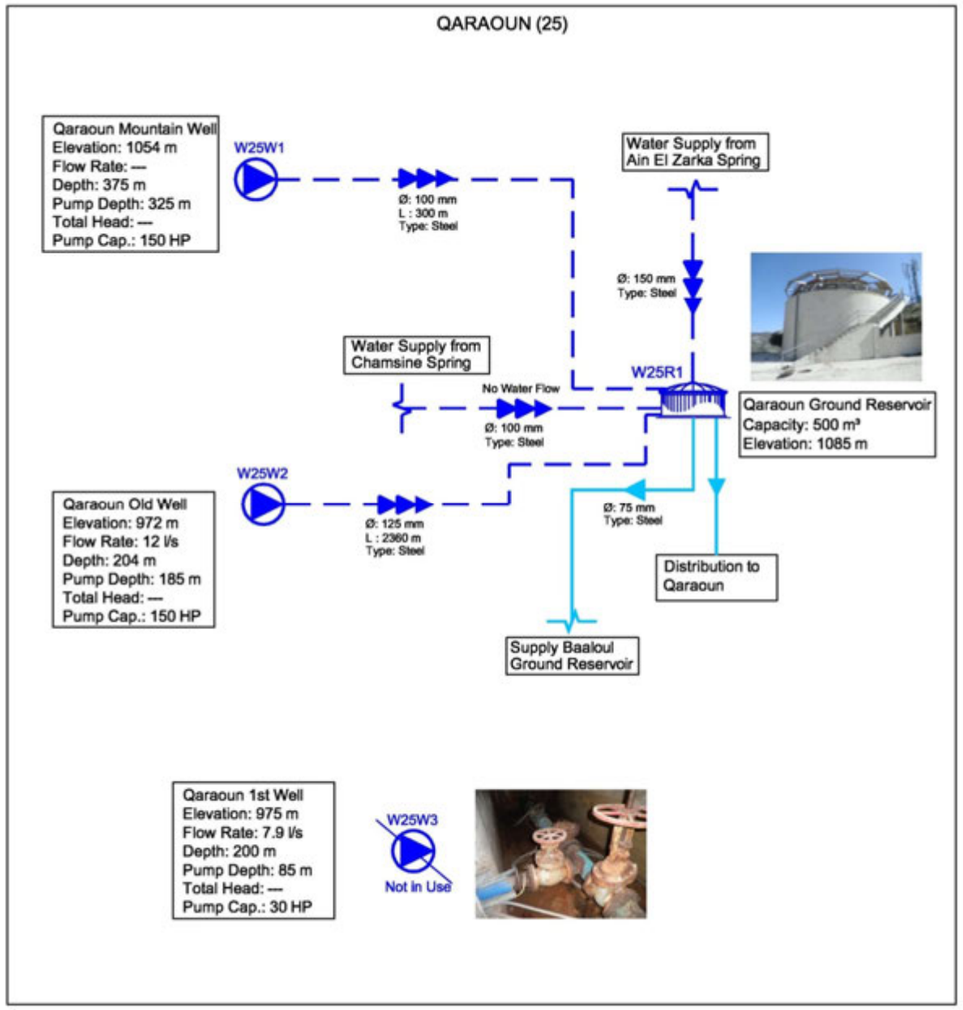
Marj (El) (24)



The existing water network is in very good condition and it has a length of around 50 km. It covers a large area of the town

Elevated tank W24ET1 (>50 years; 100 m³): Elevated tank is in acceptable condition but it needs esthetical rehabilitation. The valve chamber door is broken. This elevated tank is not in use because it has no water source.

Qaraoun (25)



The old water network is replaced by a new one in year 2000. This network is in good condition.

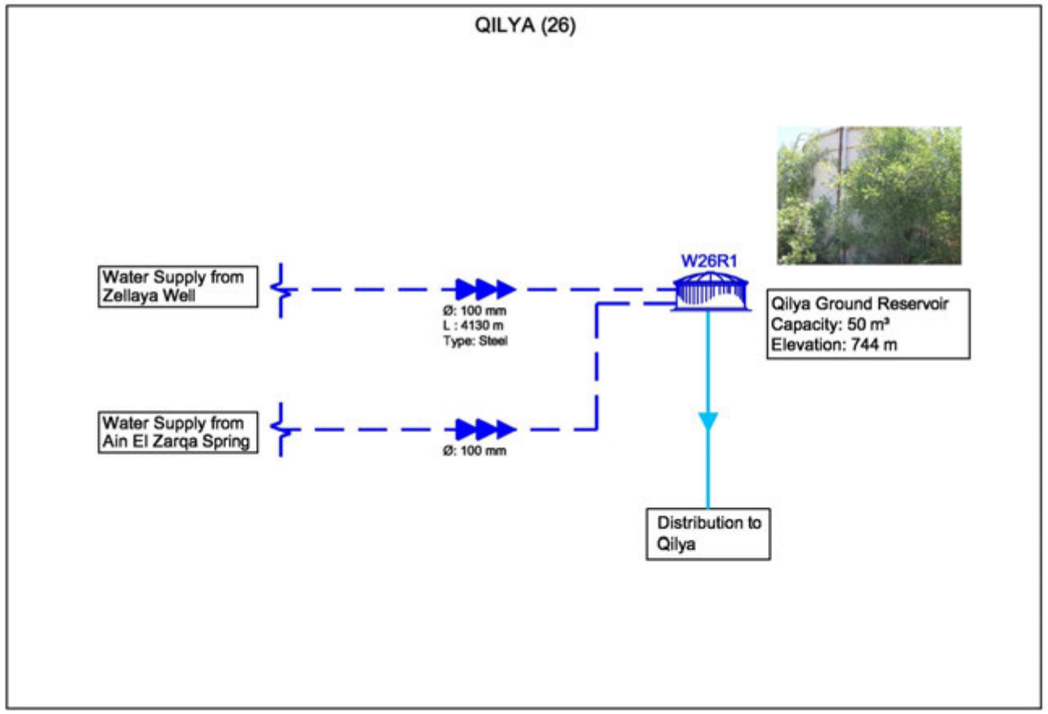
Well W25W1 (30 years old): Well suffers from a shortage of electric power. No more available information.

Well W25W2 (25 years old): Well has no water outlet. No more available information.

Well W25W3 (>45 years): Well is old and it is in bad condition. Its valves and pipes are rusted and need to be changed. This Well needs rehabilitation. This well is not in use anymore.

Reservoir W25R1 (15 years old; 500 m³): Reservoir is in good condition but there is neither level indicator nor flow meter nor overflow pipe. It needs some minor maintenance.

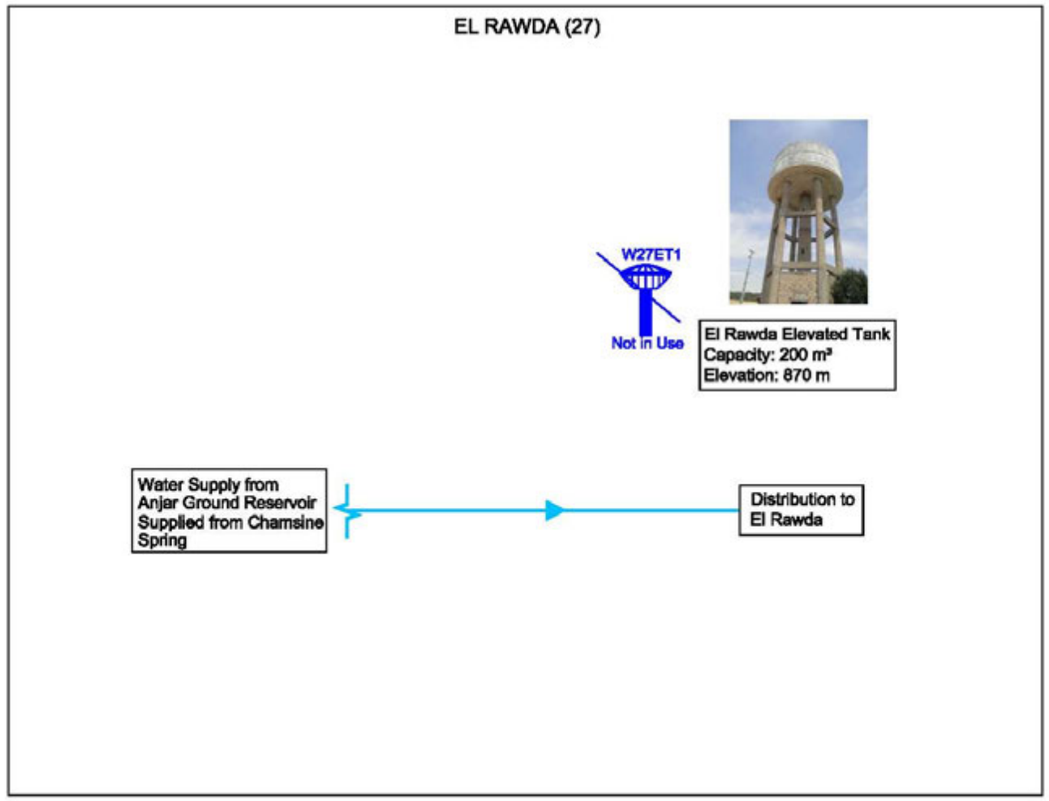
Qilya (26)



There is no available information concerning the water network of the town.

Reservoir W26R1 (50 m³): Reservoir is in acceptable condition. It is subjected to leakage it needs some minor maintenance.

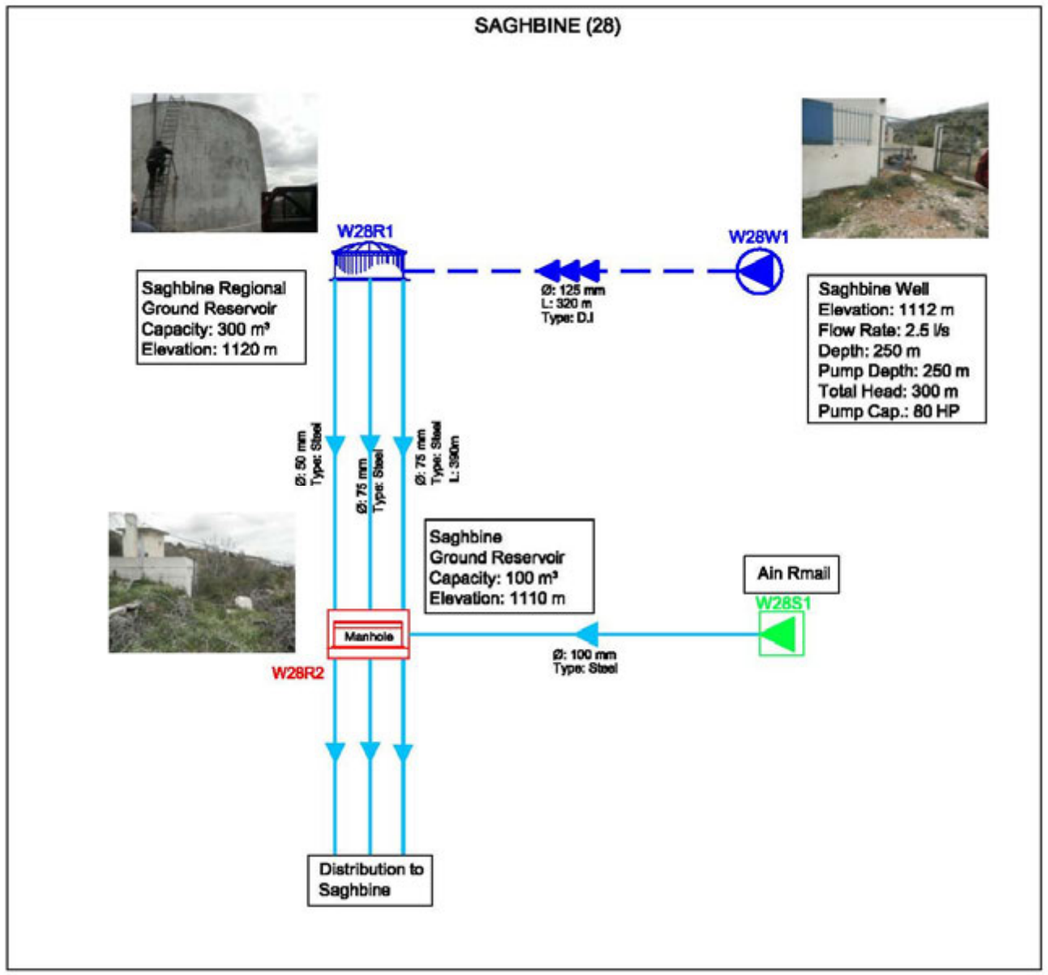
El Rawda (27)



The existing water network is in very good condition and it has a length of around 4 km. It covers a large area of the town

Elevated tank W27ET1 (200 m³): Elevated tank is old and it is not in use.

Saghbine (28)



The existing water network is in very good condition and it has a length of around 12 km. It covers a large area of the town

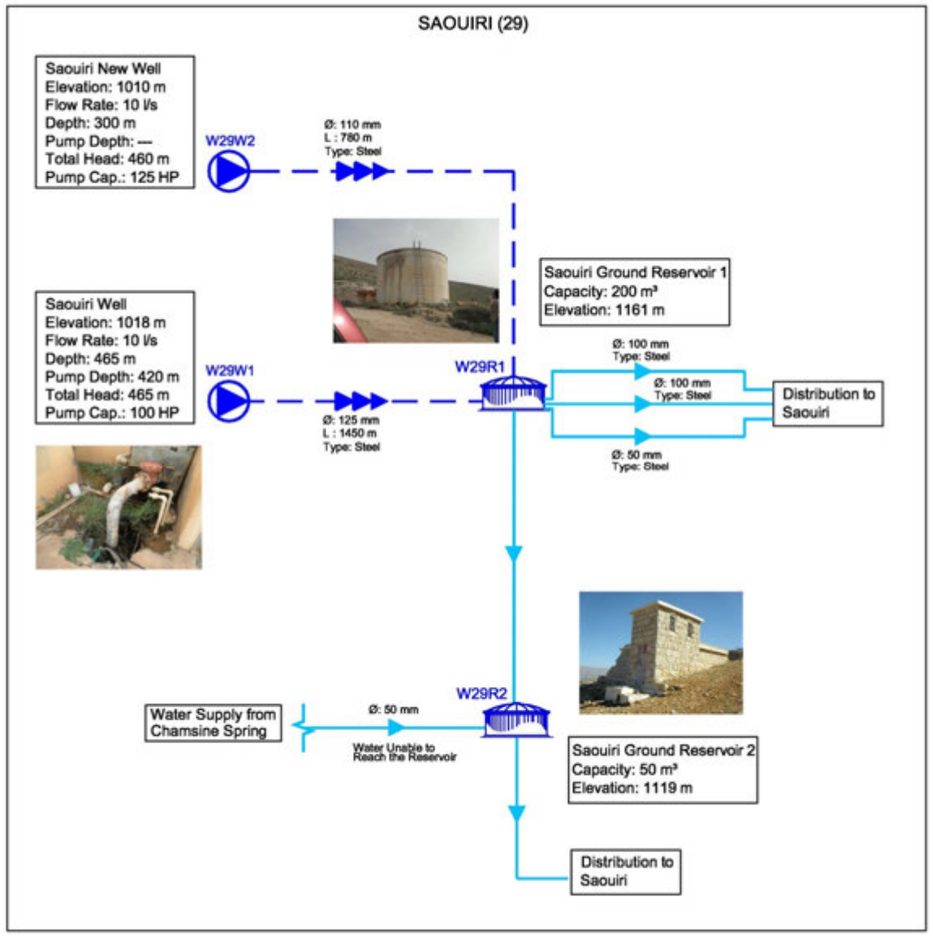
Well W28W1 (15 years old): Well is in acceptable condition. There is no chlorination unit. Well building needs rehabilitation.

Spring W28S1: No available information.

Reservoir W28R1 (>15 years; 300 m³): Reservoir is in good condition. The valve chamber is inaccessible because of vegetation. Chlorine disinfection is not functioning. This reservoir needs minor maintenance.

Reservoir W28R2 (65 years old; 100 m³): Reservoir is very old but in acceptable condition. No more available information.

Saouiri (29)



The existing water network is in very good condition and it has a length of around 45 km. It covers a large area of the town

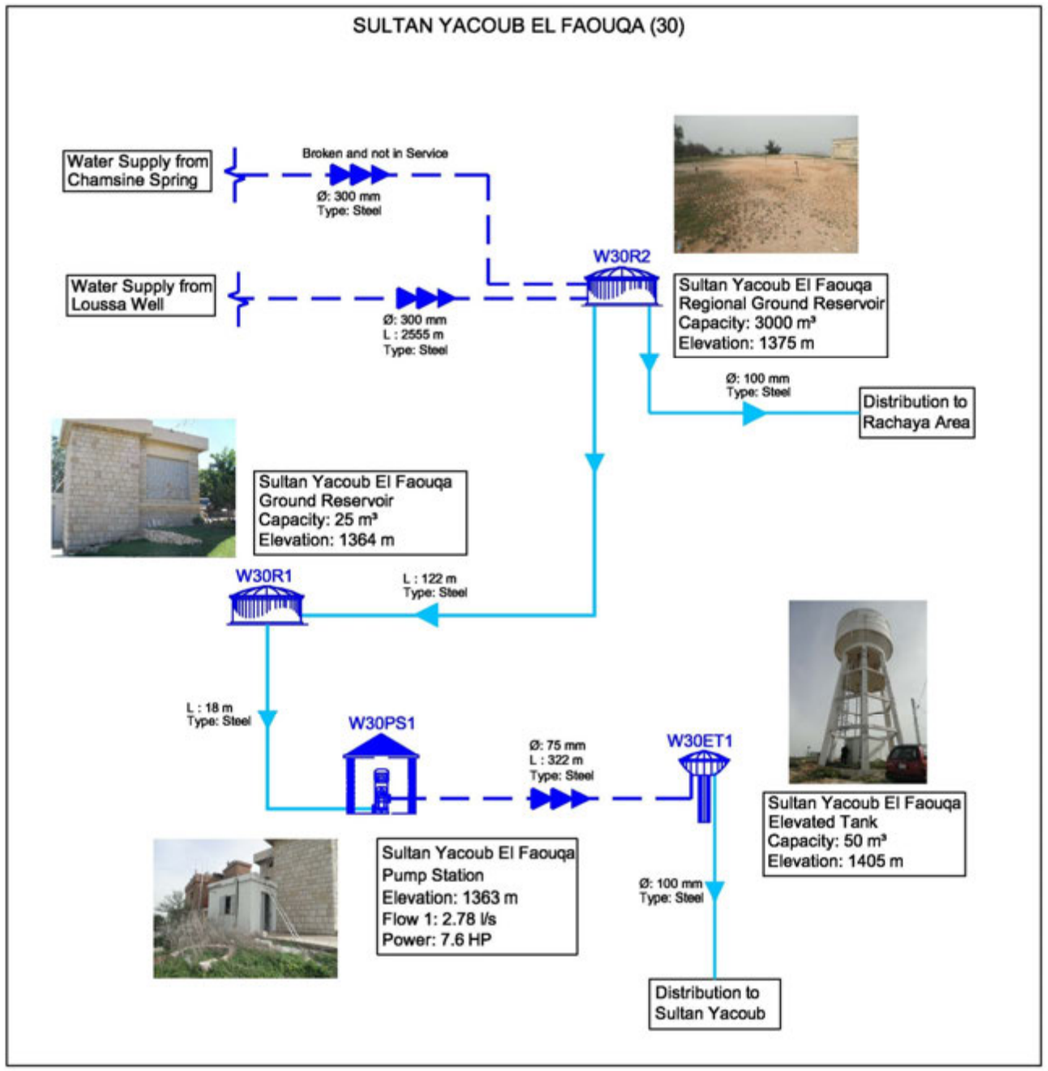
Well W29W1 (>30 years): Well is very old and it is in bad condition. Its pipes and valves are rusted and they are subjected to leakage. There is no chlorination unit and the power generator is not working. This well needs rehabilitation.

Well W29W2: No available information.

Reservoir W29R1 (15 years old; 200 m³): Reservoir is in acceptable condition but its pipes are subjected to leakage. This reservoir needs some minor maintenance.

Reservoir W29R2 (50 m³): Reservoir is very old. No more available information.

Sultan Yacoub El Faouqa (30)



The existing water network is very old (installed 20 years ago) and it is in bad condition.

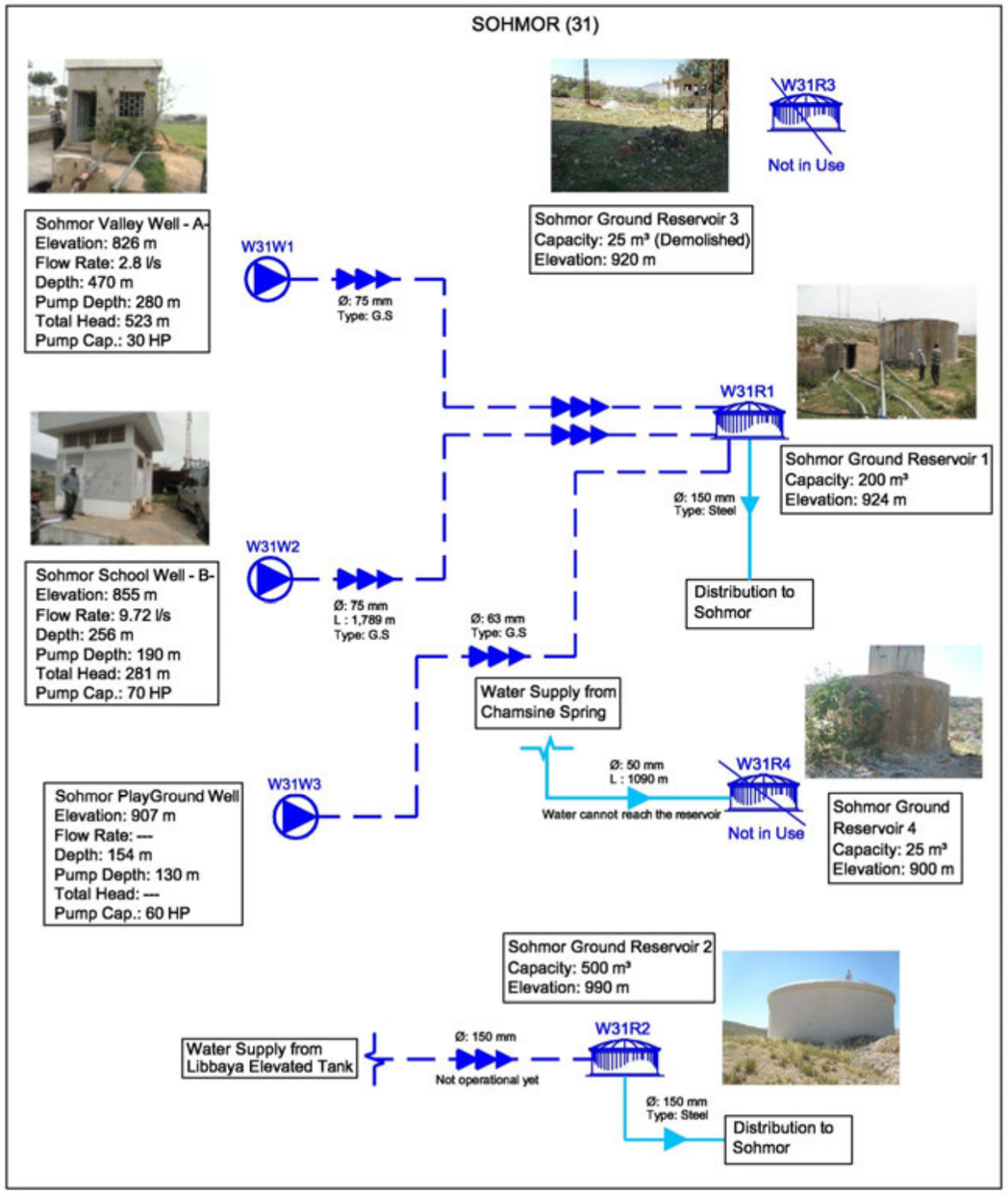
Pump station W30PS1: Pump station is old but it is in acceptable condition. Only one pump is operating. There is no standby pump.

Reservoir W30R1 (45 years old; 25 m³): Reservoir is old but it is in acceptable condition. It is subjected to leakage at the valves level and when it is full. This reservoir needs some maintenance.

Reservoir W30R2 (55 years old; 3000 m³): Reservoir is in bad condition. It needs esthetical and structural rehabilitation.

Elevated tank W30ET1 (50 m³): Elevated tank is in good condition. It was rehabilitated before visit time.

Sohmor (31)



The existing water network is very old and it is in bad condition. The old network was updated.

Well W31W1 (>15 years): Well is in acceptable condition but it suffers from a shortage of electric power. There is no chlorine disinfection in use although chlorine cylinders are available. This well needs minor maintenance.

Well W31W2 (>30 years): well is in acceptable condition but it suffers from a shortage of electric power. There is no chlorine disinfection in use although chlorine cylinders are available. The Caprari pump installed in 1975 is broken but it was replaced in 2009. This well needs minor maintenance.

Well W31W3 (15 years old): Well suffers from a shortage of electric power. No more available information.

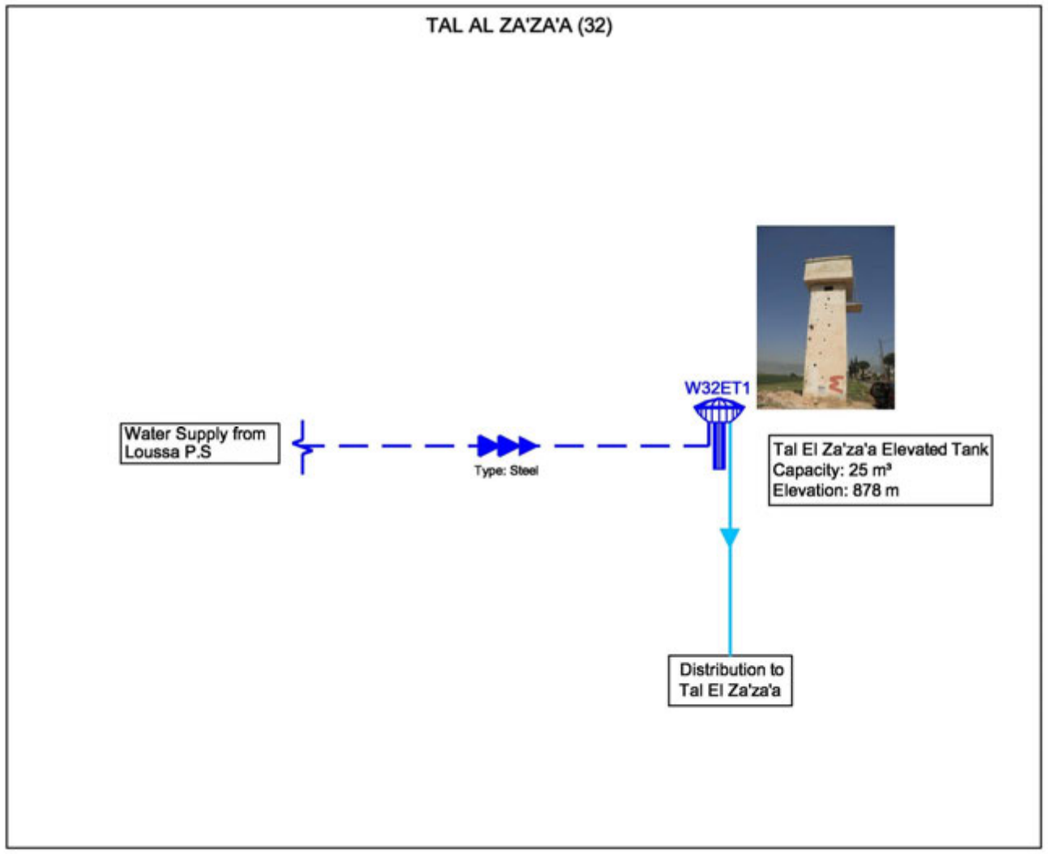
Reservoir W31R1 (35 years old; 200 m^3): Reservoir is in very poor condition. It needs structural and esthetical rehabilitation. The valve's chamber of this reservoir needs reconstruction.

Reservoir W31R2 (500 m^3): Reservoir is in good condition. No more available information.

Reservoir W31R3 (25 m^3): Reservoir is destroyed.

Reservoir W31R4 (25 m^3): Reservoir is very old and it is in bad condition. It needs rehabilitation or reconstruction. This reservoir is not in use anymore.

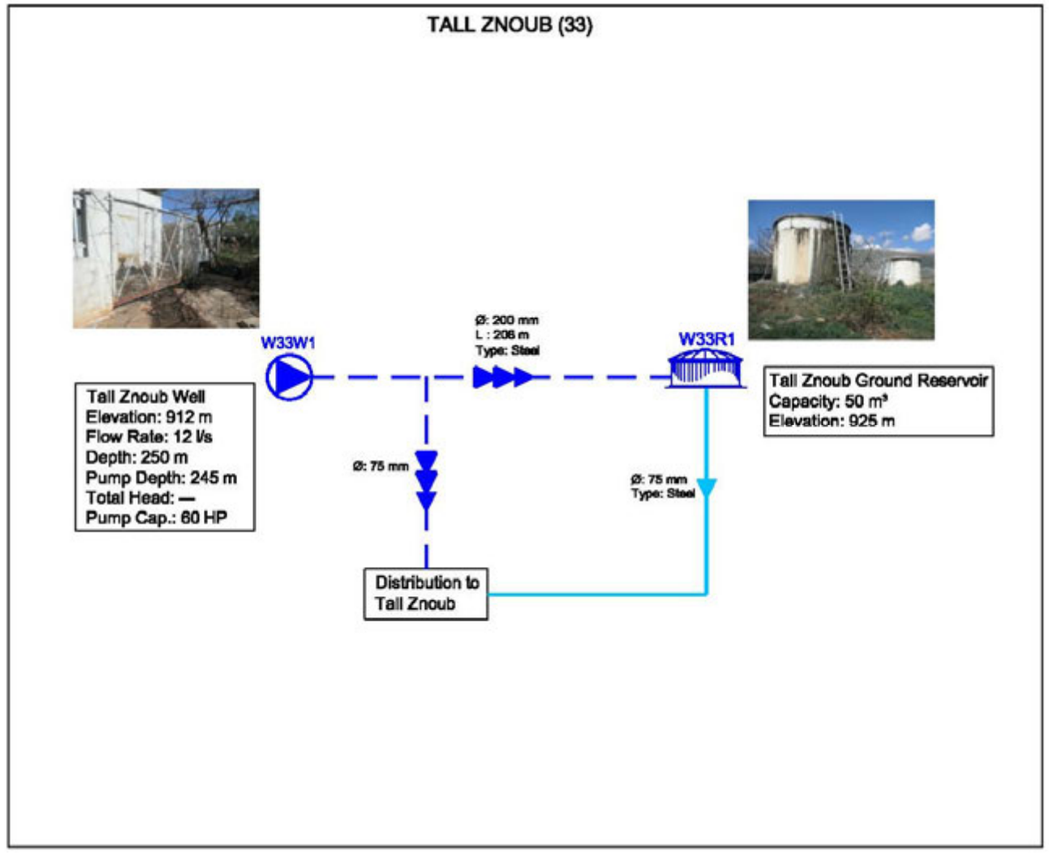
Tal al za'za'a (32)



The existing water network is in very good condition and it has a length of around 3 km. It covers a large area of the town

Elevated tank W32ET1 (55 years old; 25 m³): Elevated tank is in bad condition.

Tall Znoub (33)

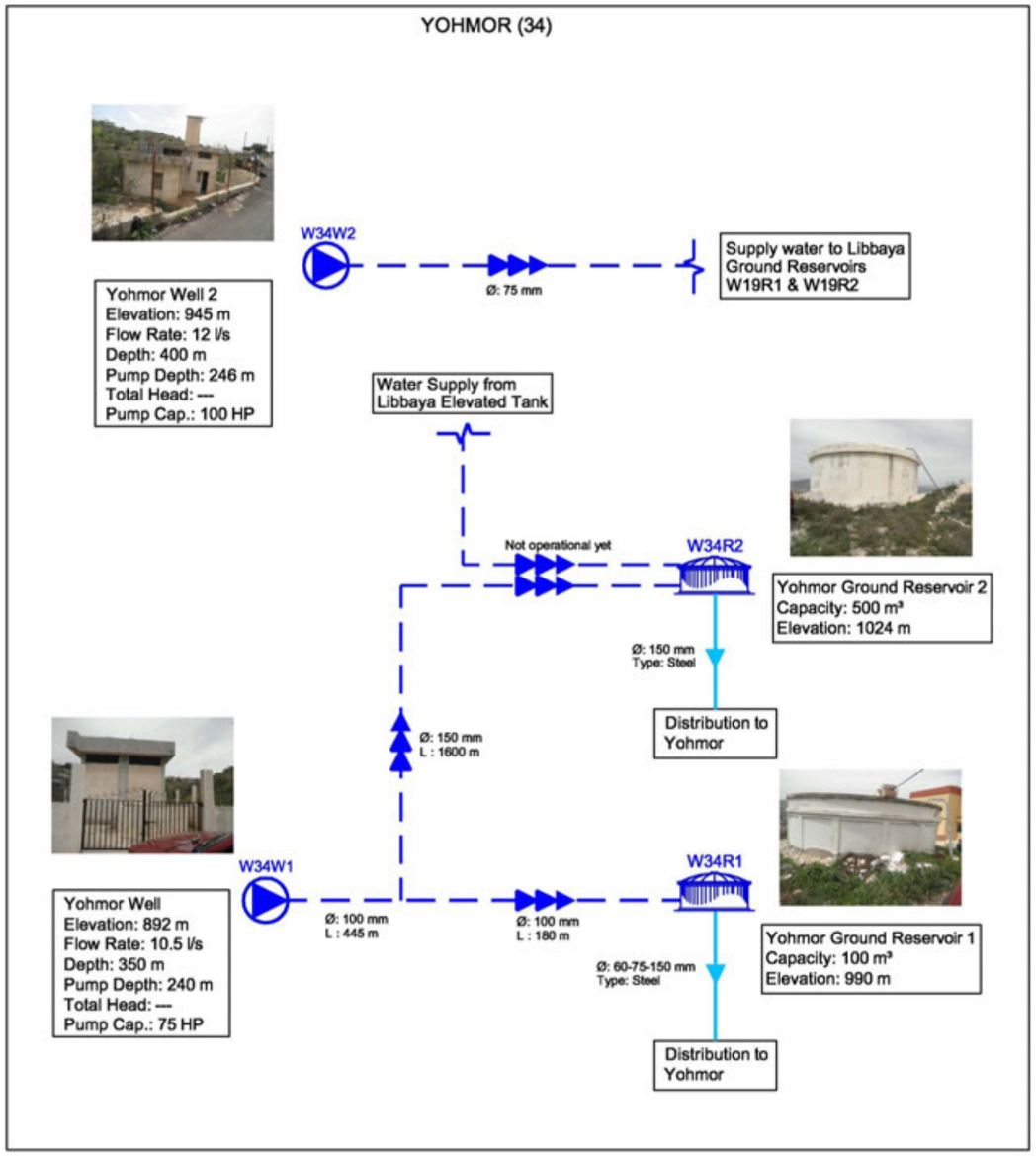


The existing water network is in very good condition and it has a length of around 4 km. It covers a part of the town

Well W33W1 (>15 years): Well is acceptable condition. The access to the building was impossible due to the absence of the keys. There is a chlorination unit but it is not in use.

Reservoir W33R1 (45 years old; 50 m³): Reservoir is in bad condition. It is subjected to severe leakage. Also, the valve chamber is flooded with water and the valves and pipes are submerged with water. This reservoir needs rehabilitation.

Yohmor (34)



The existing water network is old (installed 18 years ago) and it is in bad condition.

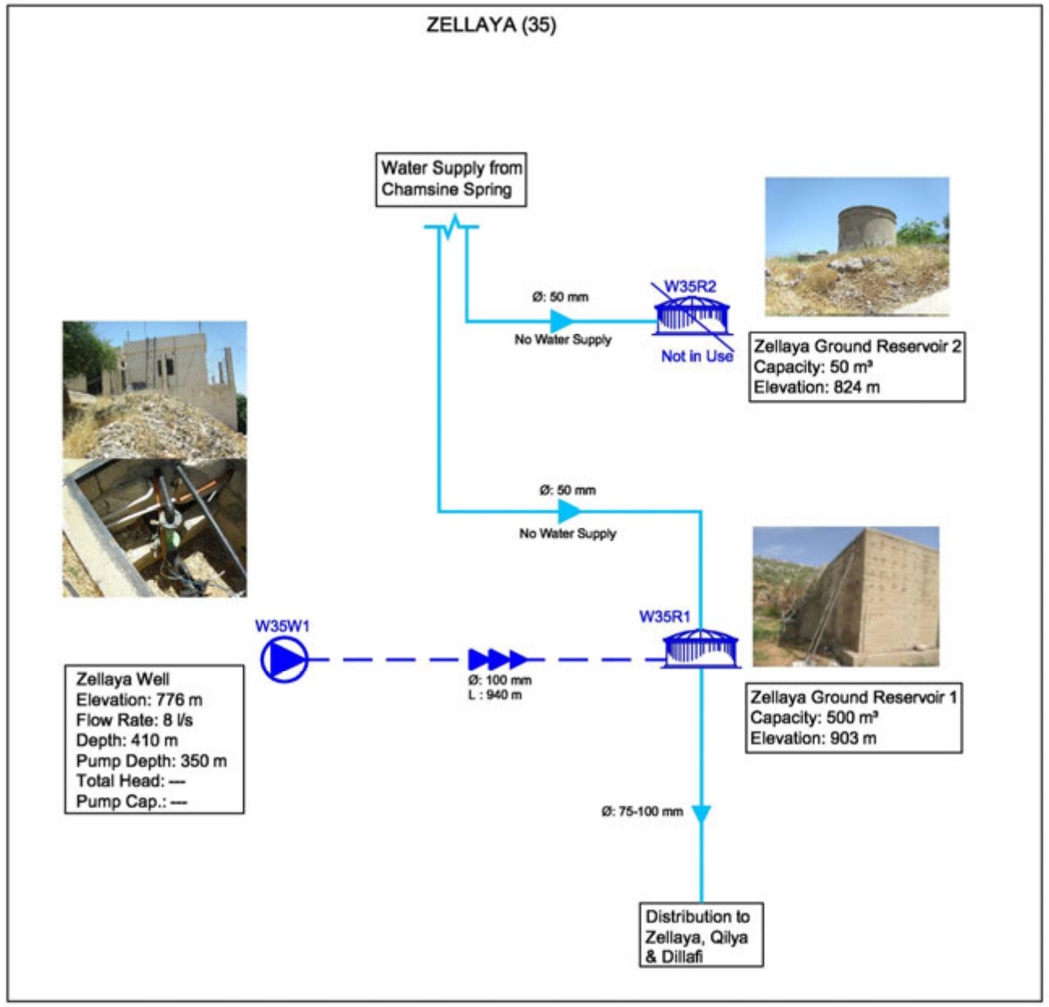
Well W34W1 (15 years ago): Well and building are in good condition but it suffers from a shortage of electric power. There is a chlorination unit but it is not in use.

Well W34W2: Well is in bad condition and it suffers from a shortage of electric power. There is no chlorination unit and the BWE had provided the chlorination unit but it is still not installed. This well needs rehabilitation and some maintenance.

Reservoir W34R1 (55 years old; 100 m^3): Reservoir is very old but it is still in acceptable condition.

Reservoir W34R2 (20 years old; 500 m^3): Reservoir is old but it is in acceptable condition. Its pipe connections are rusted and need to be changed. This reservoir needs esthetical rehabilitation and some minor maintenance.

Zellaya (35)



There is no available information concerning the water network of the town. A new line coming from Libbaya regional elevated tank will supply this village once Ain El Zarqa system becomes operational. The specific layout could not be obtained.

Well W35W1: Well is in good condition. Its chamber needs a steel cover.

Reservoir W35R1 (>30 years; 500 m^3): Reservoir is old but it is still in acceptable condition. It doesn't have an overflow pipe. This reservoir needs esthetical rehabilitation and minor maintenance.

Reservoir W35R2 (50 m^3): Reservoir is very old and it is in bad condition. It needs rehabilitation or reconstruction. This reservoir is not in use anymore.

6 RACHAIYA CAZA

6.1 Water networks

Table 6-1 summarizes the results of the data collection campaign carried out through the questionnaires and over the phone. Twenty six municipalities were contacted and 24 of them answered affirmatively regarding the existence of a water network, while Beit Lahia answered negatively and Al Aakabe provided no answer. Of the 24 answering affirmatively, only the existing network of Bakkifa was obtained. For most of the other villages, the networks are very old and are being replaced. Hence the newly constructed networks for 16 villages were obtained (designed by RELK&P in 2010 and funded by the CDR). The networks of the following villages could not be obtained: el aakabe (if it exists), Ain Aata, Aita-El-Foukhar, Haloua, Haouch El Qinnaabe, Kfar Qouq, Kfarmechki, and Yanta. For most of these villages, the networks are old and in bad condition, and hence the maps probably do not exist.

Figures 6-1 and 6-2 show that 5% of the Rachaiya population, representing 20% of the caza villages, is not served by any water networks (existing or planned), while 95% of the population representing 80% of the villages is served by existing networks or planned. A large number of these networks have been executed very recently (in the last 1 or 2 years) to replace old networks.

Plans 6-1 and 6-2 show the layout of the existing and planned water networks for the caza of Rachaiya as a whole, and the area of north, south, and west Rachaiya respectively.

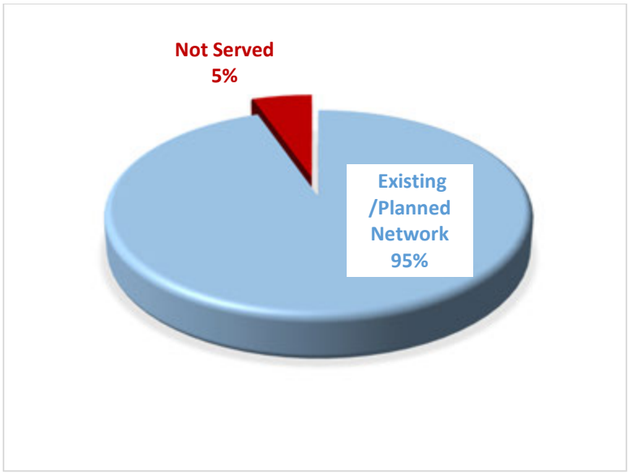


FIGURE 6-1: PERCENTAGE OF POPULATION SERVED BY WATER NETWORKS IN RACHAIYA CAZA

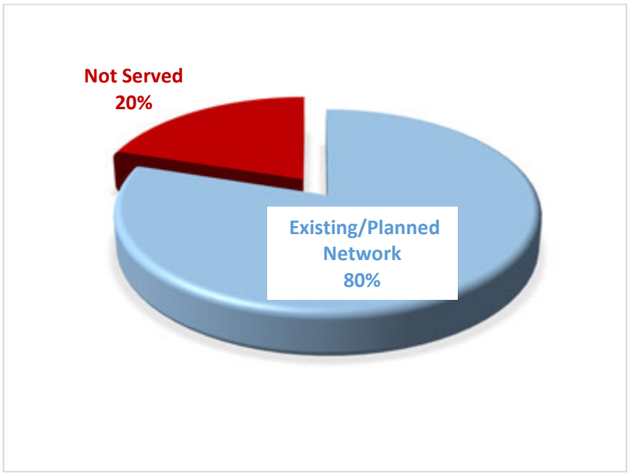
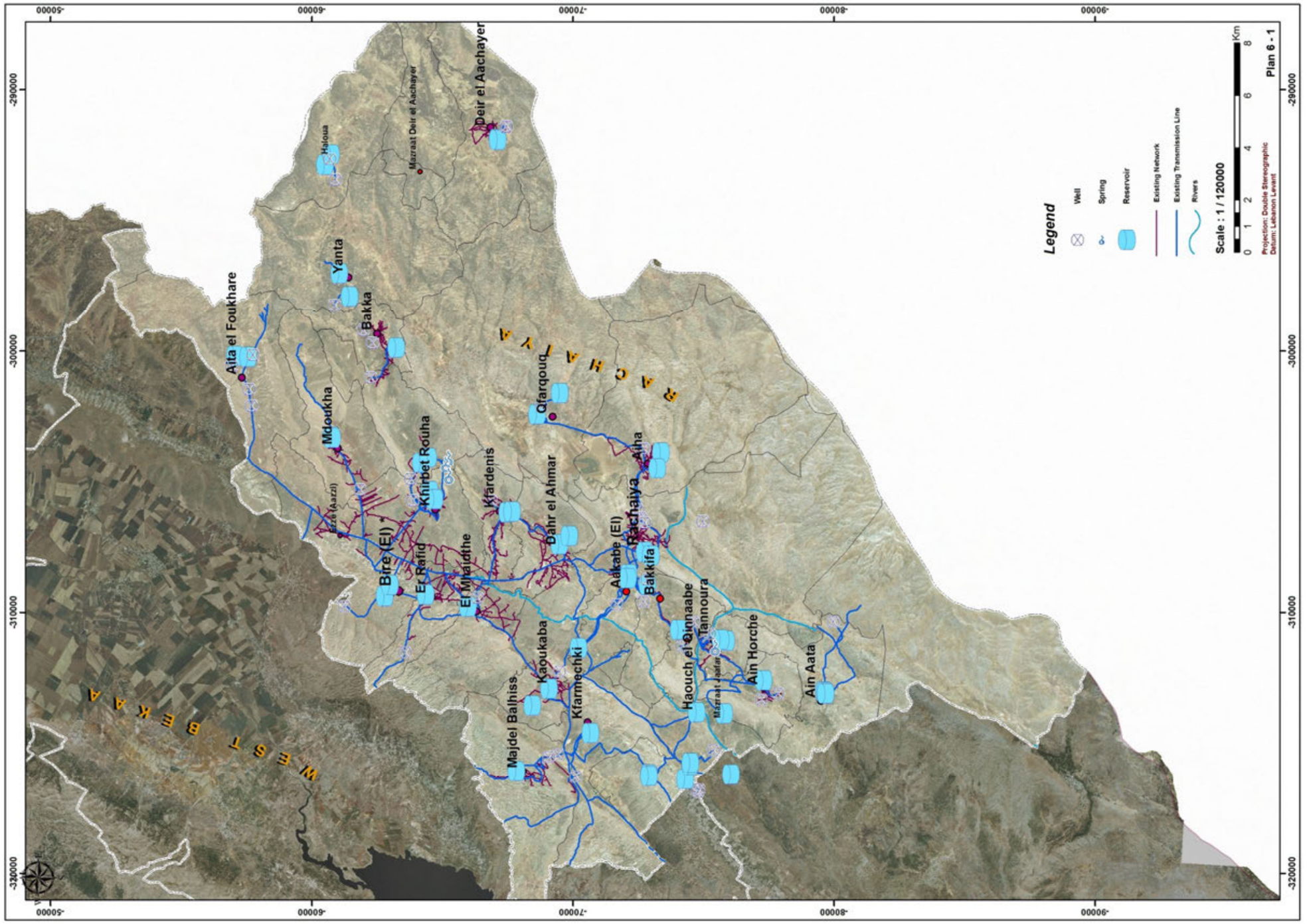


FIGURE 6-2: PERCENTAGE OF VILLAGES SERVED BY WATER NETWORKS IN RACHAIYA CAZA

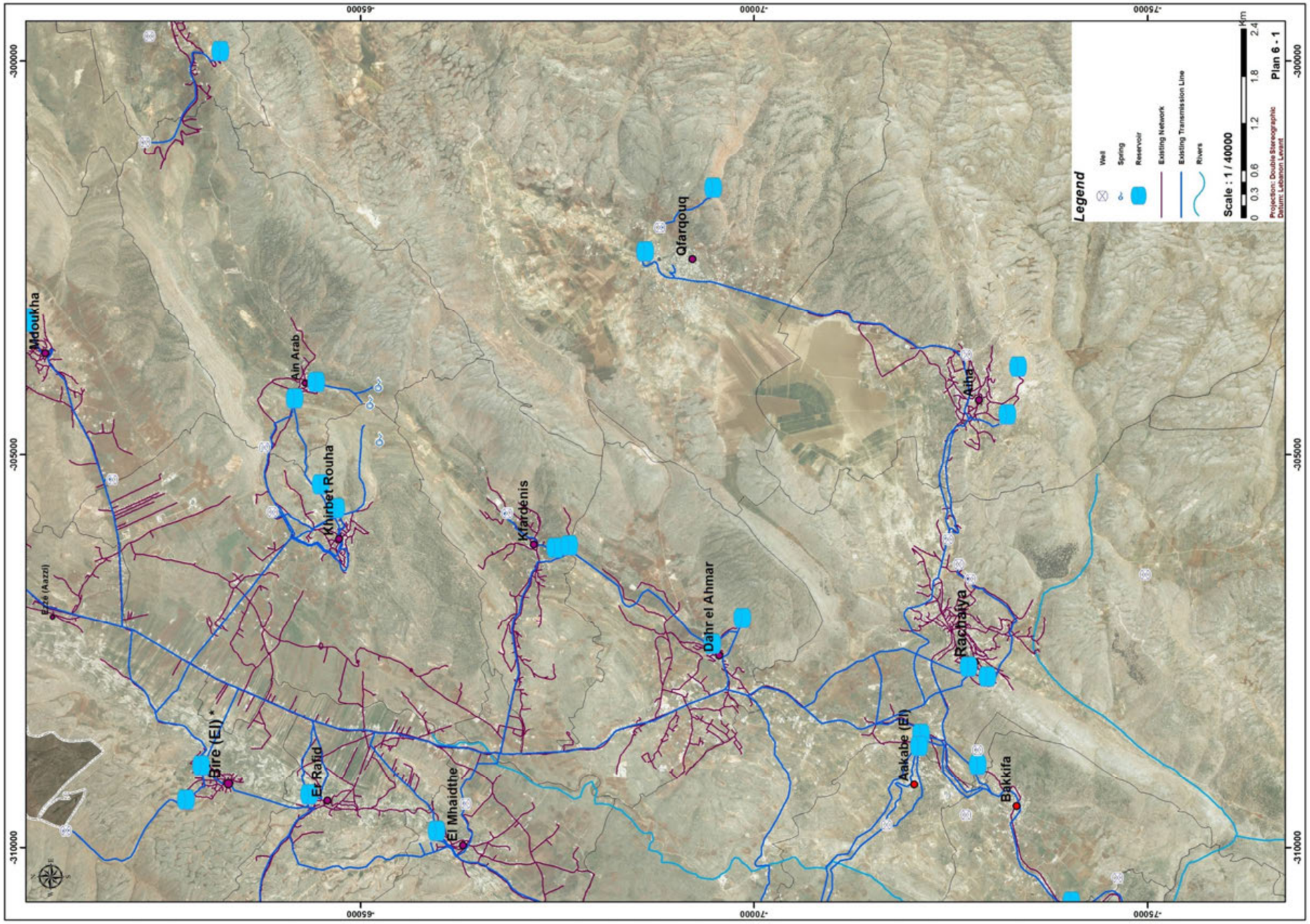
TABLE 6-1: WATER NETWORK STATUS IN CAZA OF RACHAIYA

Caza		Village Name	Information From Questionnaire/Phone Interview						Response Of Municipality To Phone Request For Water Maps	Network Maps Availability Status
			Wells	Spring	Water Network	Water Source	Network Construction Date (Year)	Status Of Water Network According To Municipality		
Rachaiya	1	**Aaiha**	Yes	No	Yes	No Answer	50 Years Old	* Network is in use but very old (bad condition) * Pipes diameters between well and reservoir range between 1" and 3"	Told us to go to BWE	Obtained - newly constructed
	2	**Aain Arab**	Yes	Yes	Yes	Spring & Chamsine Well	No Answer	* Network in good condition (spring source). * Another network is in bad condition (Chamsine well source)	Told us to go to Khatib & Alami company	Obtained - newly constructed
	3	**Aakabe (El)**	No Answer	No Answer	No Answer	No Answer	No Answer	No answer	Told us they have no time to answer	Not obtained
	4	**Ain Aata**	No Answer	No Answer	Yes	Reservoir Supplied By Spring	50 Years Old	* Network is in use and the municipality is repairing the broken pipes	Promised to help but did not follow through	Not obtained
	5	**Ain Horche**	Yes	No	Yes	Private Wells	2009	* Network is new and in use (good condition) * Pipe diameters range between 1"&4" * Network length is around 7 km	Not cooperative	Obtained - newly constructed
	6	**Aita El Foukhar**	Yes	Yes	Yes	Wells	2003	No answer	No answer	Not obtained
	7	**Bakka**	Yes	Yes	Yes	Wells	1986	* Network is in use and very old (bad condition) * New network is under construction	Told us to contact CDR and council for the south	Obtained - newly constructed
	8	**Bakkifa**	No Answer	No Answer	Yes	No Water Source	2003	* Network is not in use because no water source	Told us to go to council for the south	Obtained - existing -only main lines
	9	**Beit Lahia**	No	No	No	No Answer	No Answer	* A new project will be designed funded by Kuweity fund	No answer	No data to collect
	10	**Bire (El)**	Yes	No	Yes	Sltan Yaqoub Reservoir	1990s	* Network is in use and very old (bad condition) * Pipe diameters range between 1" and 3".	No answer	Obtained - newly constructed
	11	**Dahr El Ahmar**	No	No	Yes	No Answer	No Answer	* Network is in use and very old (bad condition)	Did not call - data already available	Obtained - newly constructed
	12	**Deir El Aachayer**	No Answer	No Answer	Yes	Well	10 Years Old	* Network is in use	Told us to go to council for the south	Obtained - newly constructed
	13	**Haloua**	Yes	No	Yes	No Answer	No Answer	* Network is in use (good condition)	Not cooperative	Not obtained
	14	**Haouch El Qinnaabe**	No	Yes	Yes	No Water Source	2005	* Network is in use and very old (bad condition) * A new well is under construction * Actually people are drinking from Chamsine well	Promised to help but did not follow through	Not obtained
	15	**Kaoukaba**	No Answer	No Answer	Yes	Wells	25 Years Old	* Network is in use but it is very old (bad condition)	Told us to go to BWE	Obtained - newly constructed

Caza		Village Name	Information From Questionnaire/Phone Interview						Response Of Municipality To Phone Request For Water Maps	Network Maps Availability Status
			Wells	Spring	Water Network	Water Source	Network Construction Date (Year)	Status Of Water Network According To Municipality		
	16	**Kfar Qouq**	Yes	No	Yes	Artisian Well	No Answer	* Network is installed by the south council * Pipe diameters range between 1" and 6"	Told us to call council for the south	Not obtained
	17	**Kfardenis**	Yes	No	Yes	No Answer	No Answer	* Network is in use and very old (bad condition) * It covers 75% of all town * Pipe diameters range between 0.5" and 6"	Did not call - data already available	Obtained - newly constructed
	18	**Kfarmechki**	Yes	No	Yes	Wells	20 Years Old	* Network is in use and very old (bad condition) * New network is under construction	Promised to help but did not follow through	Not obtained
	19	**Khirbet Rouha**	No Answer	No Answer	Yes	Wells & Chamsine Project	60 Years Old	* Network is very old and not complete (bad condition)	Not available at municipality	Obtained - newly constructed
	20	**Majdel Balhiss**	Yes	Yes	Yes	Wells	60 Years Old	* Network is in use and very old (bad condition) * People installed some pipes by their own * Pipe diameters range between 0.5" and 4"	Did not call - data already available	Obtained - newly constructed main lines
	21	**Mdoukha**	No Answer	No Answer	Yes	Well	25 Years Old	* Network is in use and very old (bad condition)	No answer	Obtained - newly constructed
	22	**Mhaidthé (El)**	Yes	No	Yes	No Answer	No Answer	* Network is in use but very old (bad condition) * It is subjected to rehabilitation from time to time * Pipe diameters range between 0.5" and 3"	Did not call - data already available	Obtained - newly constructed
	23	**Rachaya El Wadi**	No Answer	No Answer	Yes	Wells	60 Years Old	* Network is in use and very old (bad condition) * It is subjected to rehabilitation from time to time	Told us to call council for the south	Obtained - newly constructed
	24	**Rafid (Er)**	Yes	Yes	Yes	No Answer	1964	* Network is in use and very old (bad condition) * It is subjected to some rehabilitations (length 6km) * Pipe diameters range between 0.5" and 3"	Did not call - data already available	Obtained - newly constructed
	25	**Tannoura**	No Answer	No Answer	Yes	Wells	40 Years Old	* Network is in use but is very old (bad condition)	Not available at municipality	Obtained - newly constructed
	26	**Yanta**	No	No	Yes	Wells	1998	* Network is in use (medium condition)	Municipality promised to help but did not follow through	Not obtained



PLAN 6-1: WATER SYSTEMS FOR CAZA OF RACHAIYA



PLAN 6-2: WATER SYSTEMS FOR CAZA OF RACHAIYA – NORTH, SOUTH & WEST

6.2 Rachaiya Water Facilities

In the caza of Rachaiya the layout of the water facilities, along with their assessment are included for 27 localities. The other 8 localities do not have any BWE facilities. Some of these villages are supplied with water from another village (in which case this will be shown on the schematics of that village), while the others rely on private wells and/or non-serviced sources or on privately acquired water. As can be seen on some of the layouts, some facilities are not connected to the system because no information could be obtained about their position relative to the other facilities. A large number of Rachaiya villages will be provided by water from the Ain El Zarqa spring system once it becomes operational.

In the caza of Rachaiya, 33% of the reservoirs have a capacity of less than a 100 m^3, 2 % only have a capacity between 1000 and 2000 m^3, and 54 % have a capacity between 100 and 500 m^3, distributed equally between the ranges 100-200 m^3; and 200-500 m^3. There are no reservoirs with a capacity larger than 2000 m^3 (figure 6-3). As shown in figure 6-4, 18 % only of all the reservoirs (ground reservoirs and elevated tanks) were found to be in good condition, 23% need minor improvements and/or maintenance, while 38% need major rehabilitation or reconstruction. For about 21 % of the reservoirs, not enough information to conduct an assessment could be gathered. This percentage is high due to the fact that for the caza of Rachaiya a number of the facilities listed in this study were not included in the BWE original database and related documentation. They were rather added as of late following oral communications with BWE staff and some new informal plans that were uncovered. As for the wells, they are divided in two categories, namely functional and non-functional. However, a functional well may need various types of improvements to become efficient as it could be providing water intermittently or insufficiently. Overall, 34 % of the Rachaiya wells are currently non-functional (figure 6-5),

Table 6-2 lists the 13 springs identified to date in the caza of Rachaiya as being used as a water source. Unfortunately for none of these springs is data available regarding the minimum, maximum, or average flows.

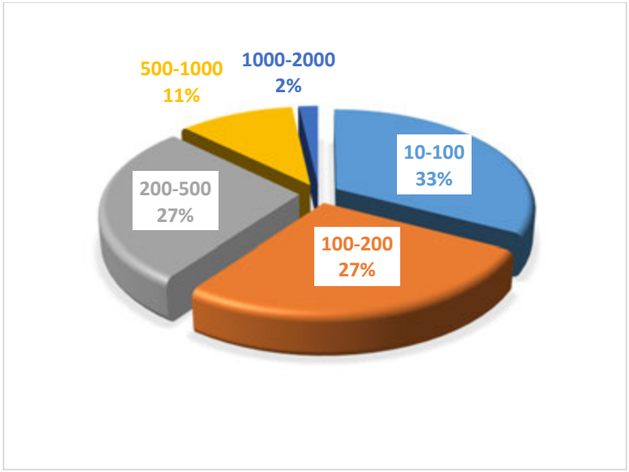


FIGURE 6-3: RESERVOIRS CAPACITY IN RACHAIYA CAZA (IN M^3)

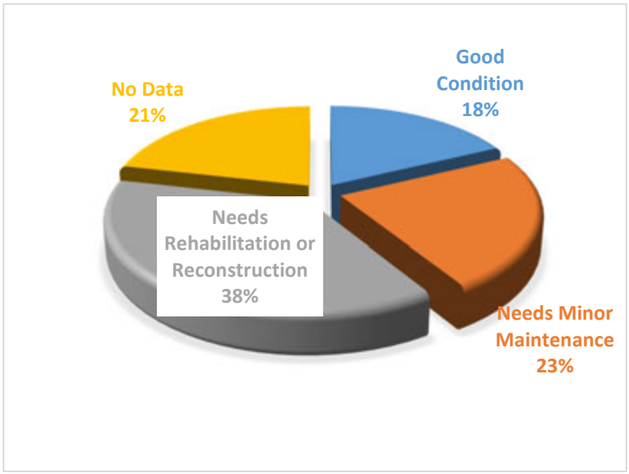


FIGURE 6-4: RESERVOIRS CONDITION IN RACHAIYA CAZA

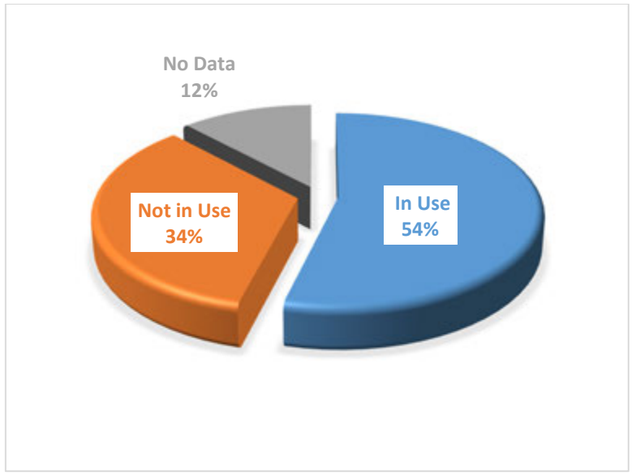


FIGURE 6-5: WELLS STATUS IN RACHAIYA CAZA

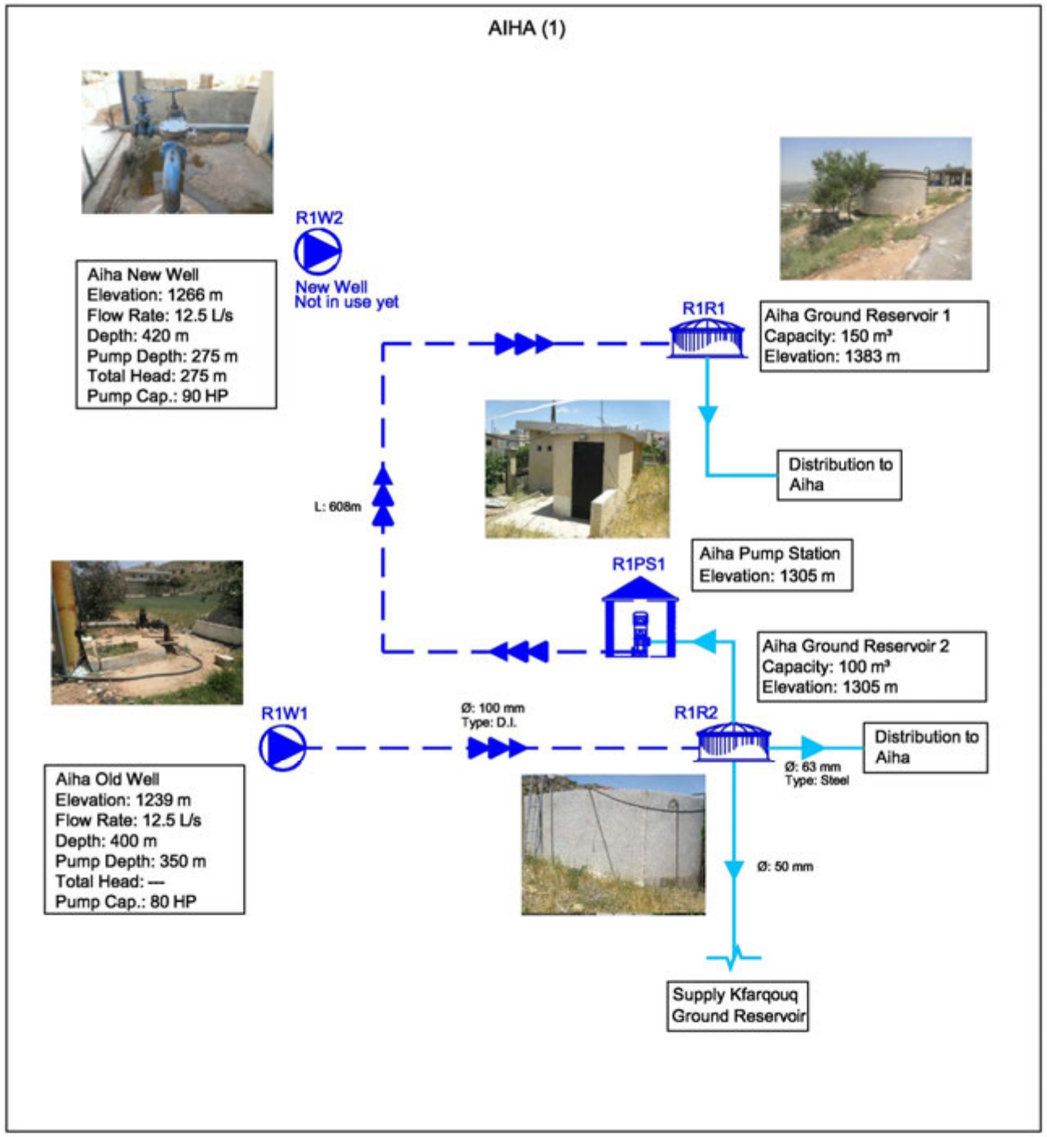
TABLE 6-2: SPRINGS IN RACHAIYA CAZA

Casa	Spring Name	Village	Code	Elevation	Min. Flow (L/S)	Max. Flow (L/S)	Avg. Flow (L/S)	Comments
Rachaiya	Ain Arab	Ain Arab	R2S2					Not in use, based on BWE current data
	Ain Bakka	Ain Arab	R2S1					
	Ain El Abed	Haouch El Qinnabe	R14S2					
	Ain El Maleh (Ain Aata)	Ain Aata	R4S1					
	Ain Fares	Haouch El Qinnabe	R14S1					
	Ain Mansia	Yanta	R28S1					
	Ain Qunia	Mdoukha	R22S1					
	Ain Safsaf		R16S1					Exact location unknown
	Ain Tell Remian	Khirbet Rouha	R19S1					
	Aita El Foukhar	Aita El Foukhar	R6S1,2,3,4,5					
	Name Unknown		R7S1					Exact location unknown, data from RELK&P
	Name Unknown		R7S2					Exact location unknown, data from RELK&P
	Name Unknown		R27S1					Exact location unknown, data from RELK&P

Legend:


LEGEND:
Gravity Pipe - Existing
Pressure Pipe - Existing
Pump Station - Existing
W.T.P
WTP
Well - Existing
Spring
Elevated Tank - Existing
Reservoir - Existing
CL
Chlorinator

Aiha (1)



The existing water network is in very good condition and it has a length of around 17.5 km. It covers a large area of the town a new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

Well R1W1 (15 years old): Well is in bad condition and it suffers from a shortage of electric power. The outlet pipe is rusted. There is no chlorination unit for this well nor a private generator. Its electrical panel is broken. It has a booster pump but it is not working. This well needs rehabilitation.

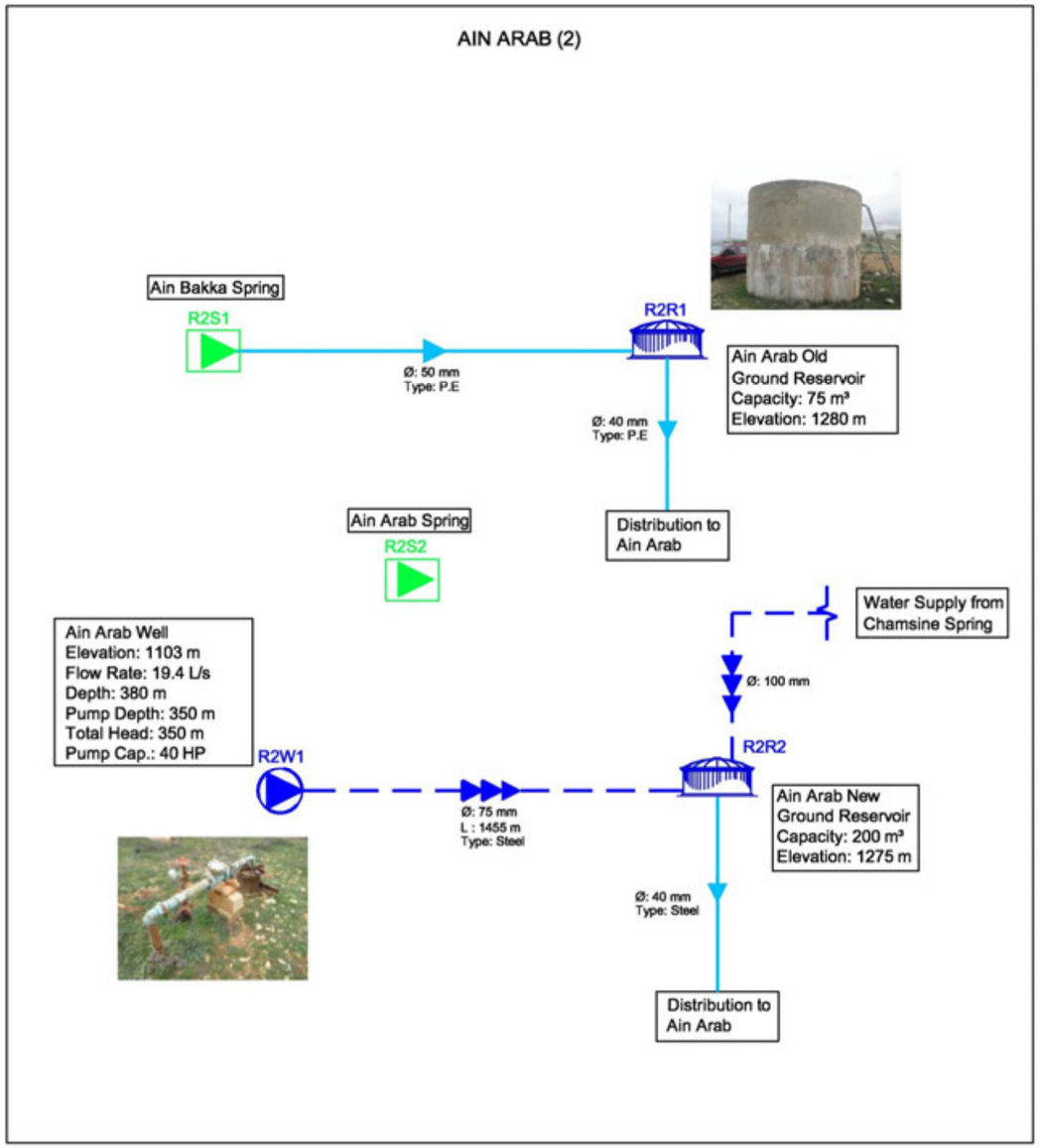
Well R1W2 (25 years old): New well not in use yet.

Pump station R1PS1: No available information.

Reservoir R1R1 (150 m³): Reservoir is very old. Its pipes are rusted. This reservoir needs rehabilitation or reconstruction.

Reservoir R1R2 (> 50 years; 100 m³): No available information.

Ain arab (2)



The existing water network is in very good condition and it has a length of around 5.5 km. It covers a large area of the town. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

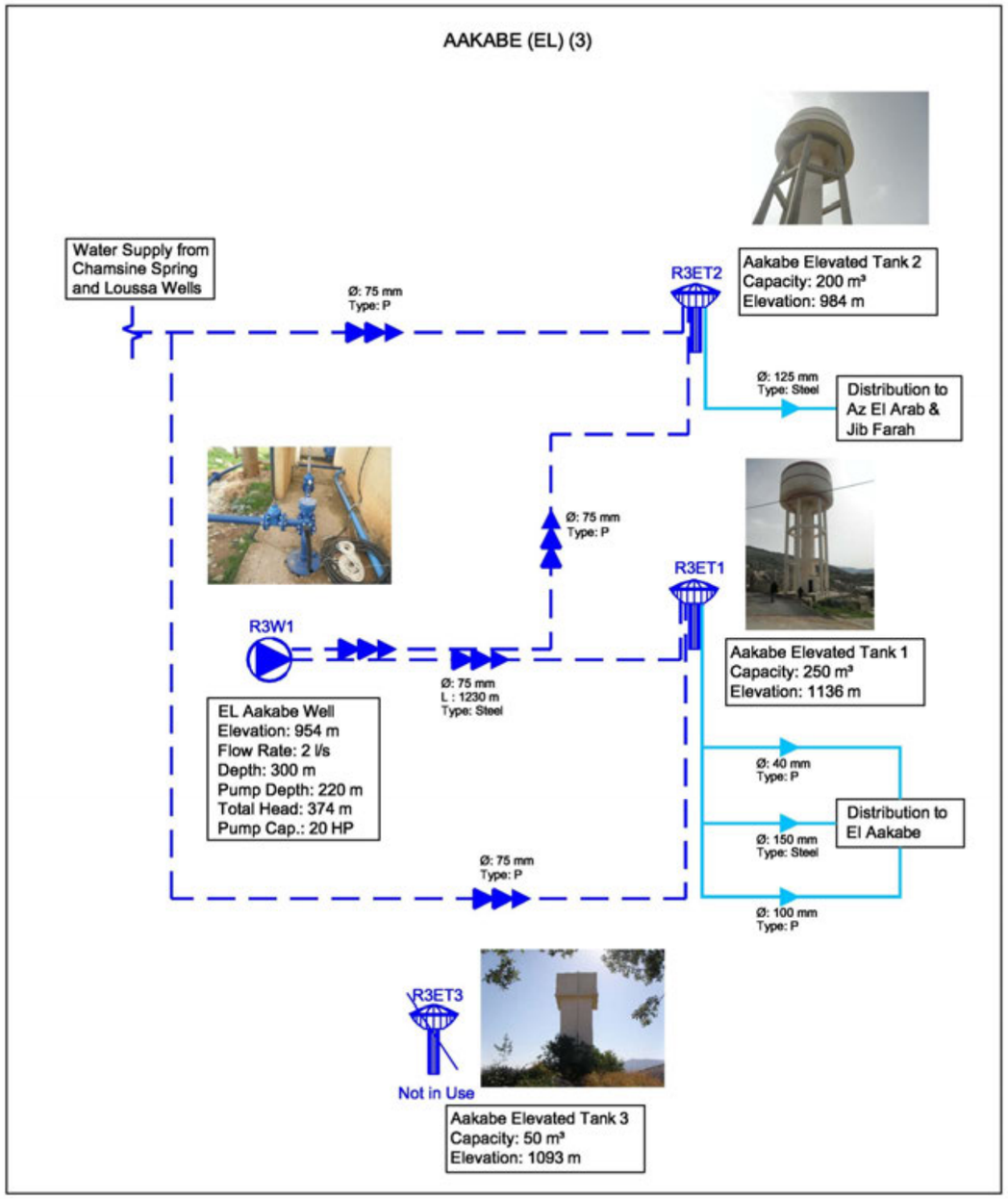
Well R2W1 (10 years old): Well is in bad condition. There is chlorination unit but it is not working. Actually people stop using the water of this well because it is polluted.

Spring R2S1 & R2S2: No available information

Reservoir R2R1 (>60 years; 75 m³): Reservoir is very old and it is in very bad condition. Its valve chamber is submerged with water. This reservoir needs reconstruction.

Reservoir R2R2 (200 m³): No available information.

Aakabe (el) (3)



There is no available information concerning the water network of the town. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

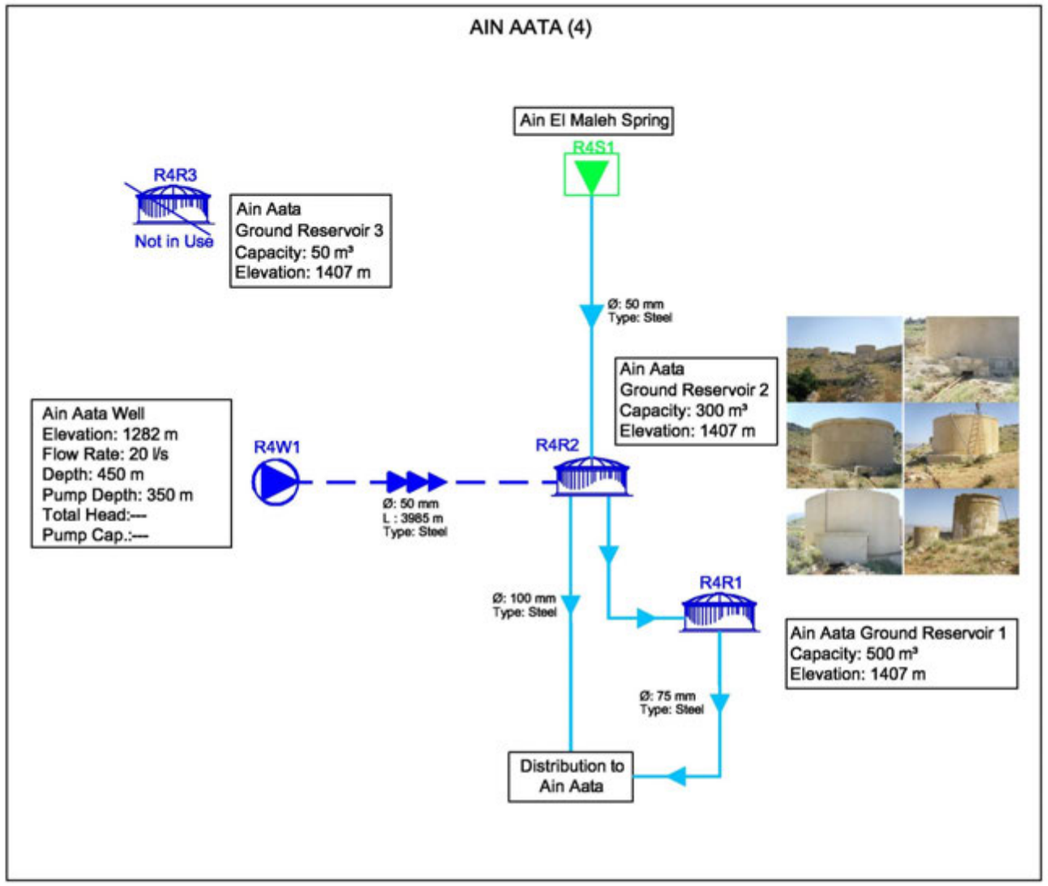
Well R3W1 (15 years old): Well is in good condition but it suffers from a shortage of electric power. The old booster pump was replaced by a new one lately. There is no chlorination unit but water is cleaned through blue boxes contains aggregates.

Elevated tank R3ET1 (250 m³): Elevated tank is in good condition. Its valve chamber is submerged with water and some valves are missing. This tank needs some minor maintenance (adding valves, fixing some pipes…).

Elevated tank R3ET2 (<10 years; 200 m³): Elevated tank is in very good condition.

Elevated tank R3ET3 (<15 years; 50 m³): Elevated tank is in very old and it is not in use.

Ain Aata (4)



The existing water network is very old (installed 50 years ago) and it is in bad condition. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

Well R4W1 (15 years old): Well is not accessible. No available information.

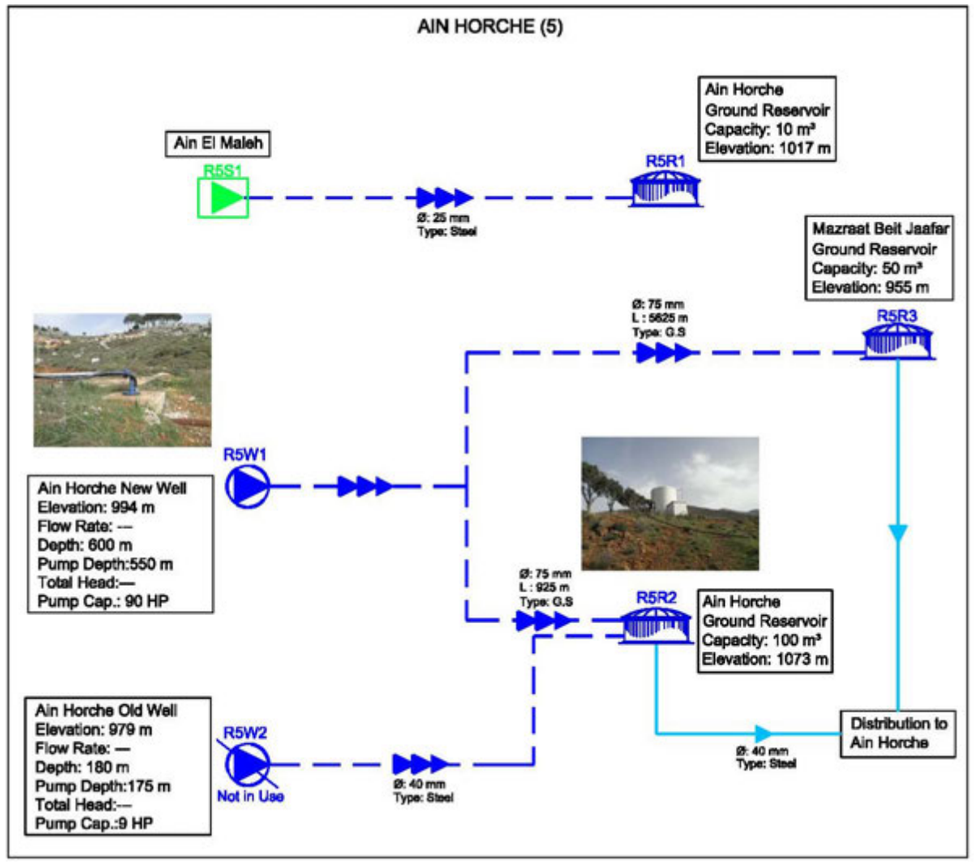
Spring R4S1: No available information.

Reservoir R4R1 (500 m³): Reservoir is in good condition.

Reservoir R4R2 (300 m³): Reservoir is in good condition.

Reservoir R4R3 (50 m³): It is not in use.

Ain Horche (5)



The existing water network is in very good condition and it has a length of around 5 km. It covers a large area of the town. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

Well R5W1 (>10 years): Well is in good condition but it suffers from a shortage of electric power and leakage when pump is running. It needs minor maintenance.

Well R5W2 (20 years old): Well is not equipped and dry. It is not in use.

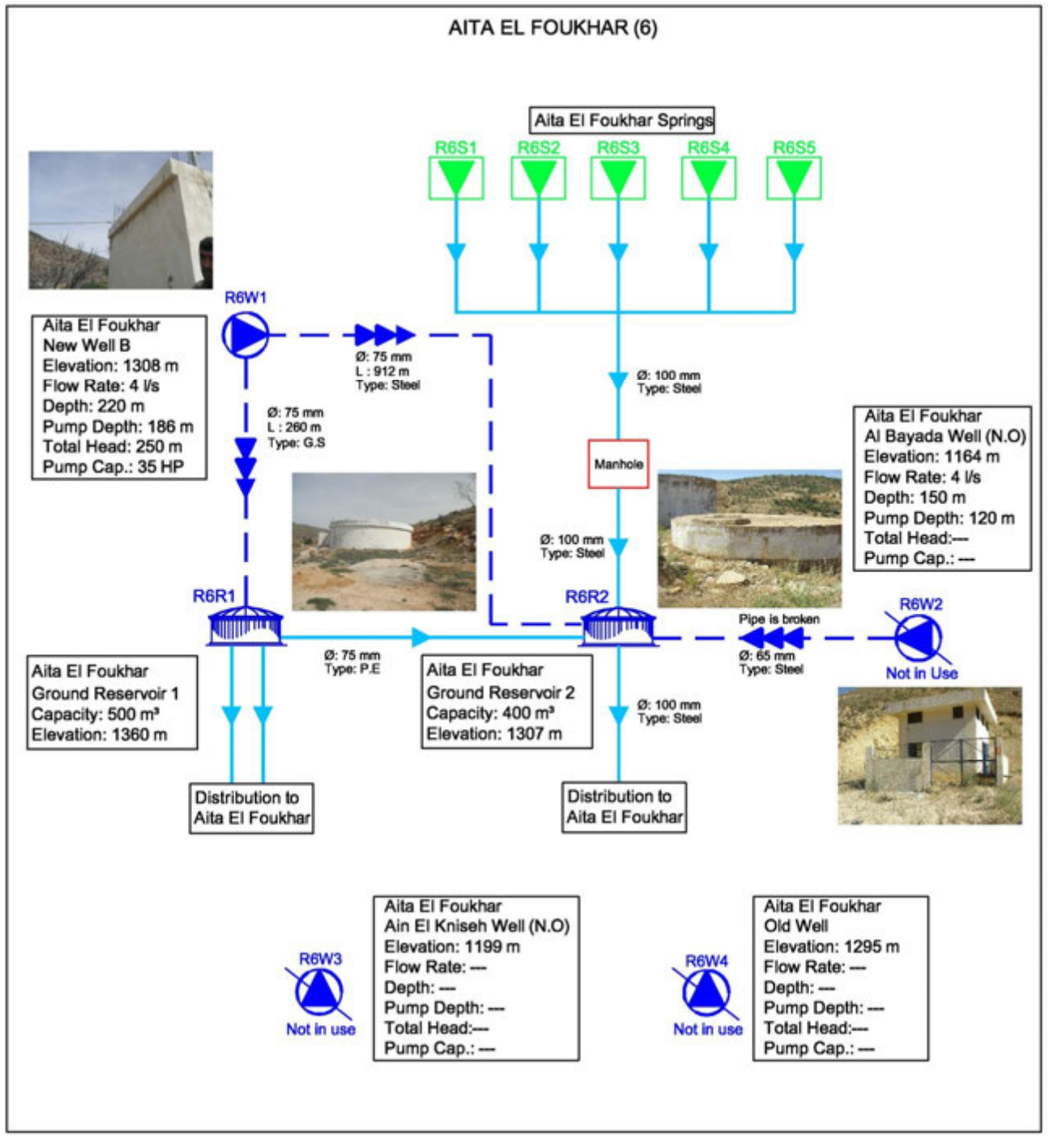
Spring R5S1: No available information.

Reservoir R5R1 (10 m³): No available information.

Reservoir R5R2 (>50 years; 100 m³): Reservoir is in acceptable condition.

Reservoir R5R3 (50 m³): No available information.

Aita El Foukhar (6)



There is a water network in the town since year 2003 but there is no available information concerning this network. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

Well R6W1 (>10 years): Well was built in year 2002. Its chamber was inaccessible during visit time. Its submersible pump is not functioning.

Well R6W2 (15 years old): Well is not in functioning nor equipped. Its outlet pipe is broken due to bombing. It is not in use.

Well R6W3 (35 years old): Well is not in use due to lack of water.

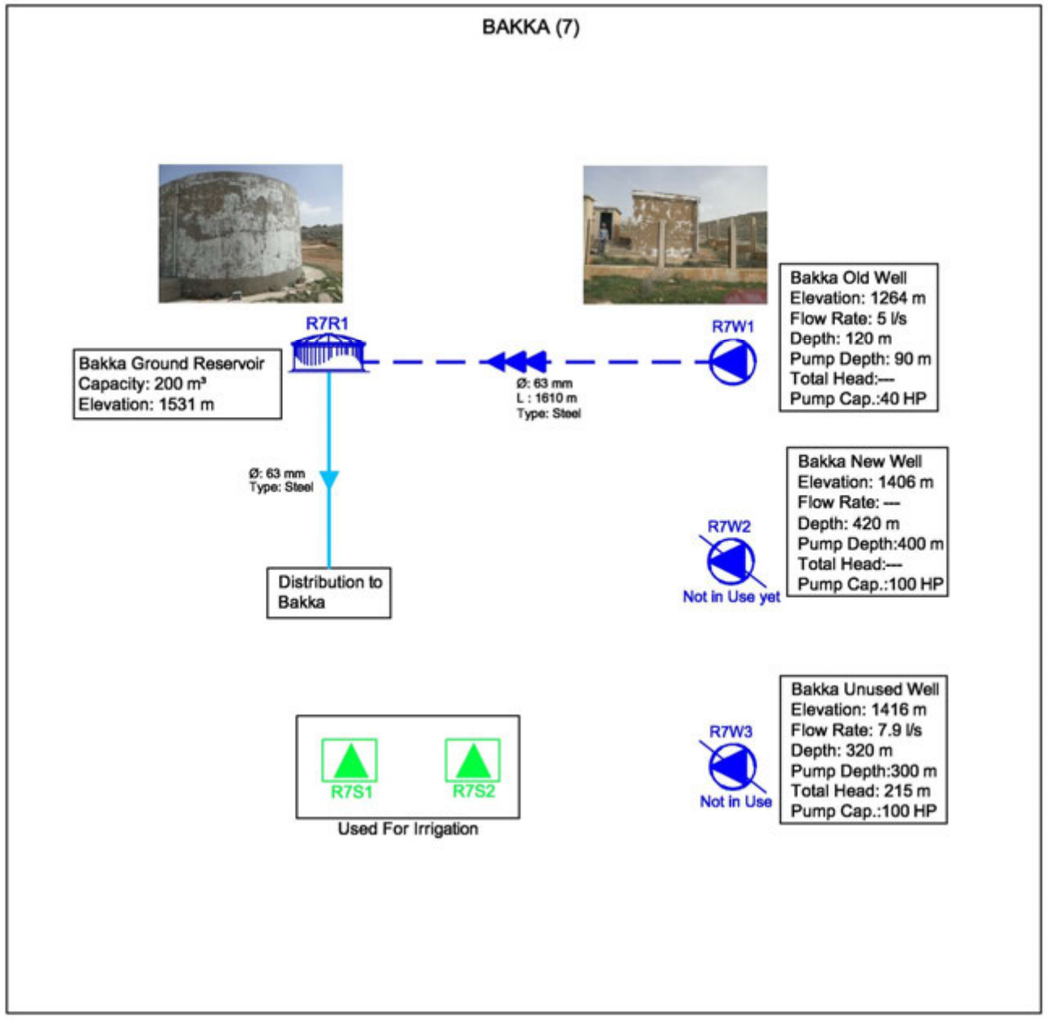
Well R6W4 (>25 years): Well is very old and it is not in use.

Spring R6S1, 2, 3, 4, 5: No available information.

Reservoir R6R1 (500 m³): Reservoir is in good condition. It has a disinfection unit.

Reservoir R6R2 (>10 years; 400 m³): Reservoir is in acceptable condition. It needs some minor maintenance and esthetical rehabilitation.

Bakka (7)



The existing water network is in very good condition and it has a length of around 10.5 km. It covers a large area of the town. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

Well r7W1 (25 years old): Well is in bad condition and it suffers from a shortage of electric power. The outlet pipe is rusted. There is no chlorination unit for this well nor a private generator.

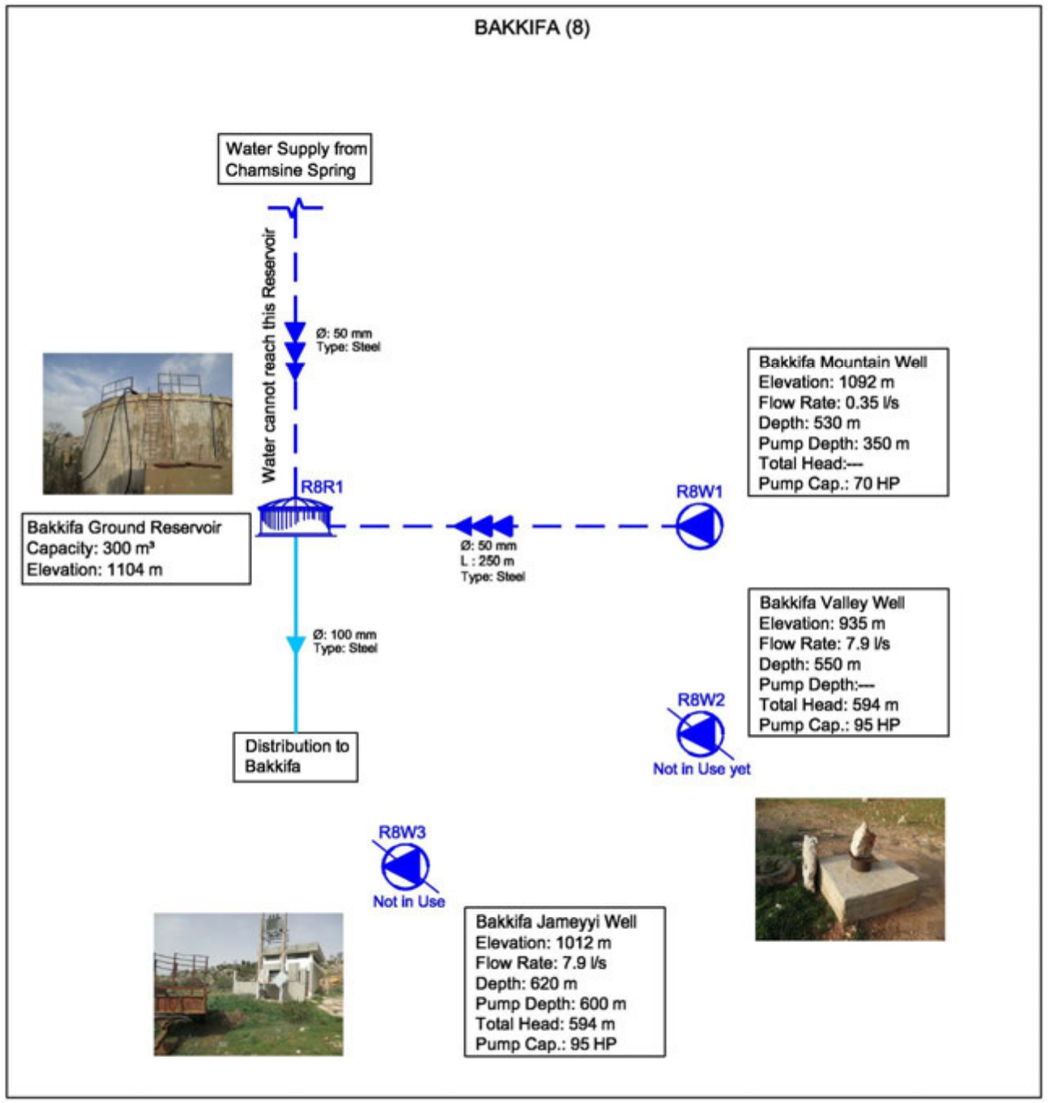
Well R7W2 (5 years old): Well is still new but it is not in use yet.

Well R7W3: Well is not in use due to lack of water. This well is very old and it has an old booster pump.

Spring R7S1& 2: Springs are used for irrigation.

Reservoir R7R1 (>20 years; 200 m³): Reservoir is old and it is in acceptable condition. The valves are not beside the reservoir and there is no valve chamber. This reservoir needs a valve chamber, some minor maintenance and esthetical rehabilitation.

Bakkifa (8)



The existing water network is in good condition and it has a length of around 2.3 km. It covers a large area of the town. This network is not in use because there is no water source available. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

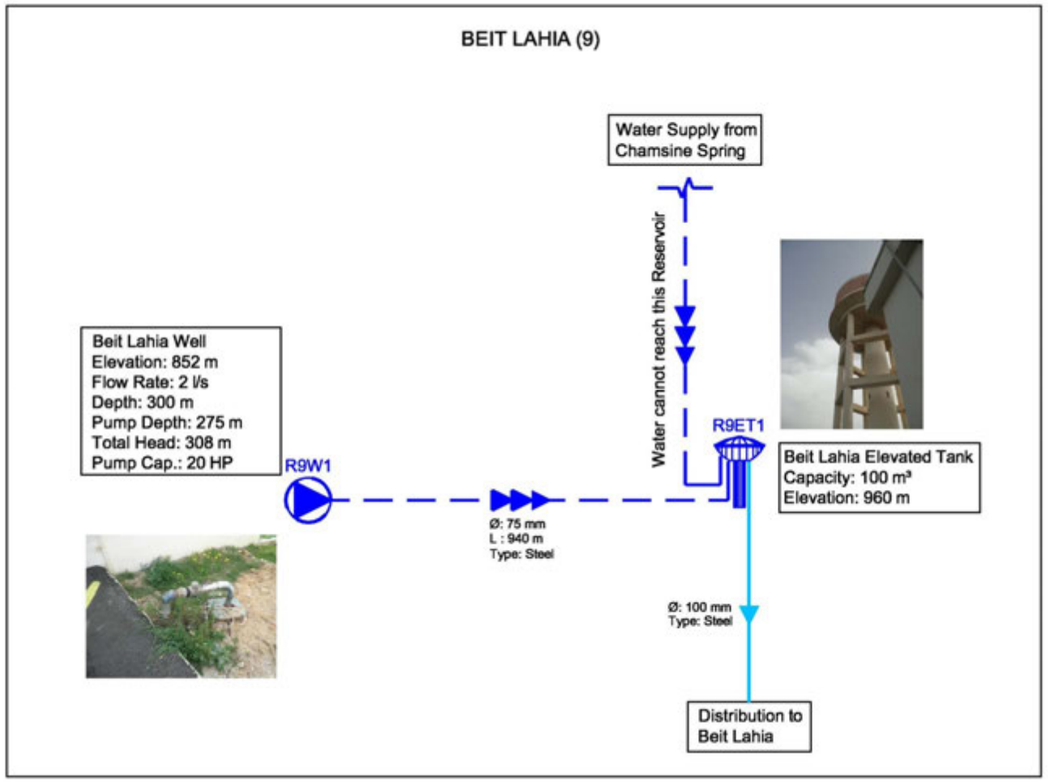
Well R8W1 (35 years old): Well is in bad condition and it suffers from a shortage of electric power. Its outlet pipe is rusted. It needs minor rehabilitation.

Well r8W2 (>5 years): Well was not in use yet during visit time. Its borehole is drilled and a casing was installed. There is no submersible nor centrifugal pump yet.

Well R8W3 (>10 years): Well is not operational due to lack of water. This well is closed by stones and its building is used as a depot for livestock.

Reservoir R8R1 (>60 years; 300 m³): Reservoir is empty due to lack of water. It is old and its pipes are rusted. This reservoir needs structural and esthetical rehabilitation.

Beit Lahia (9)

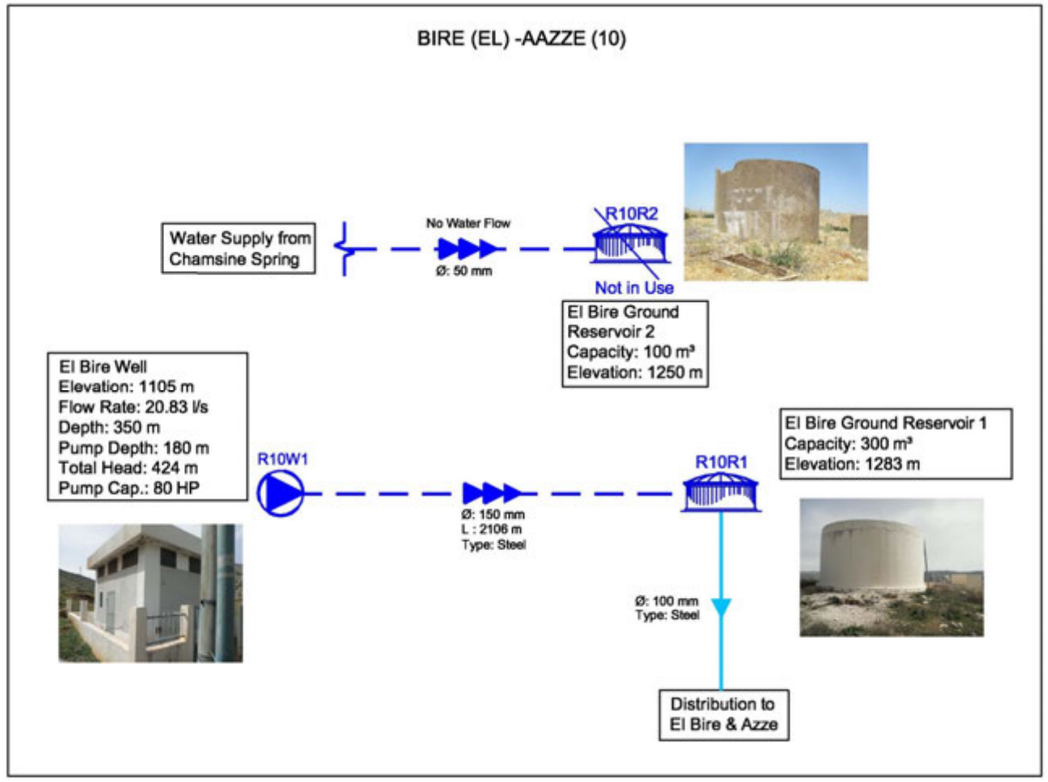


The existing water network is in very good condition and it has a length of around 1.5 km. It covers a large area of the town. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

Well R9W1 (>15 years): Well is in bad condition and it suffers from a shortage of electric power. It has a chlorination unit but it is not working because it needs rehabilitation. Its pipes are rusted and shall be changed. A new outlet pipe shall be installed.

Elevated tank R9ET1 (>15 years; 100 m³): Elevated tank is old but it is in acceptable condition. It is subjected to leakage. It needs some minor maintenance.

Bire (El) -Aazze (10)



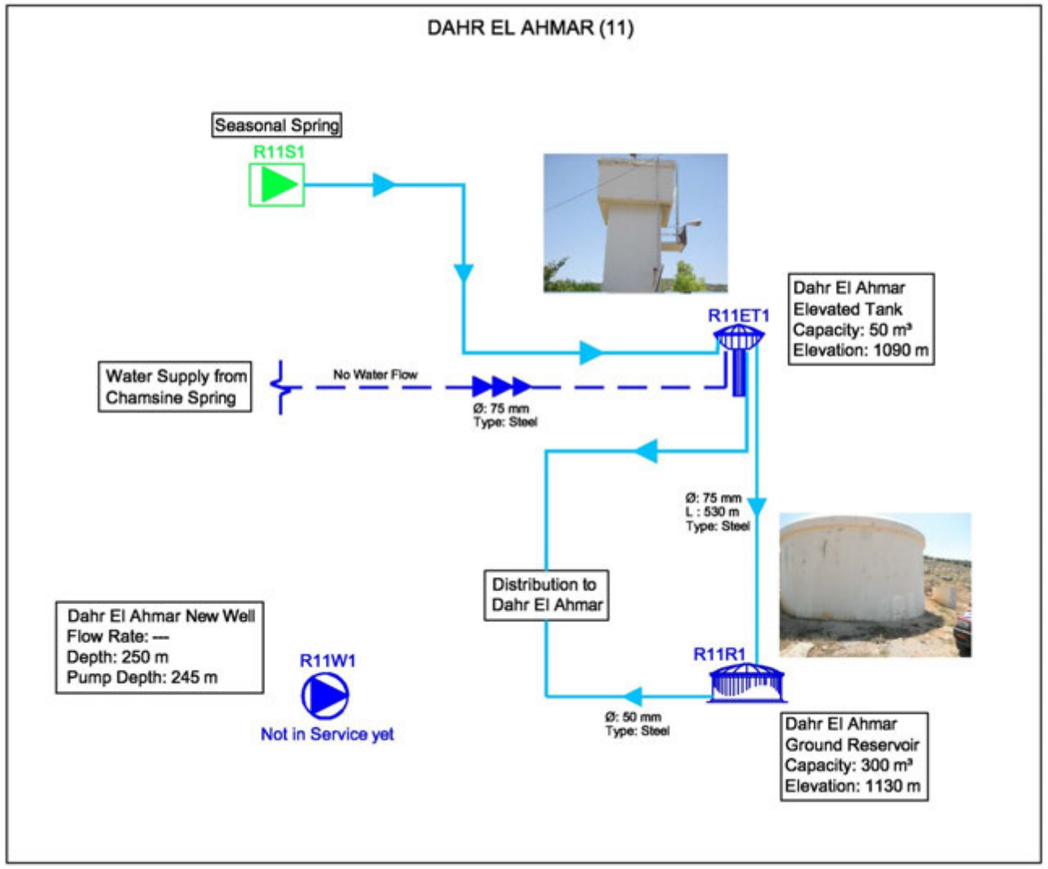
The existing water network is in very good condition and it has a length of around 25 km. It covers a large area of the town. A new line coming from Ain El Zarqa spring and Jabal El Arabi regional reservoir will supply this village once the system becomes operational. The specific layout could not be obtained.

Well R10W1 (15 years old): Well is in bad condition and it suffers from a shortage of electric power. There is no chlorination unit for this well.

Reservoir R10R1 (>15 years; 300 m³): Reservoir is in good condition.

Reservoir R10R2 (100 m³): Reservoir is very old and it is in bad condition. It is not in use. It needs reconstruction.

Dahr El Ahmar (11)



The existing water network is in very good condition and it has a length of around 26 km. It covers a large area of the town. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

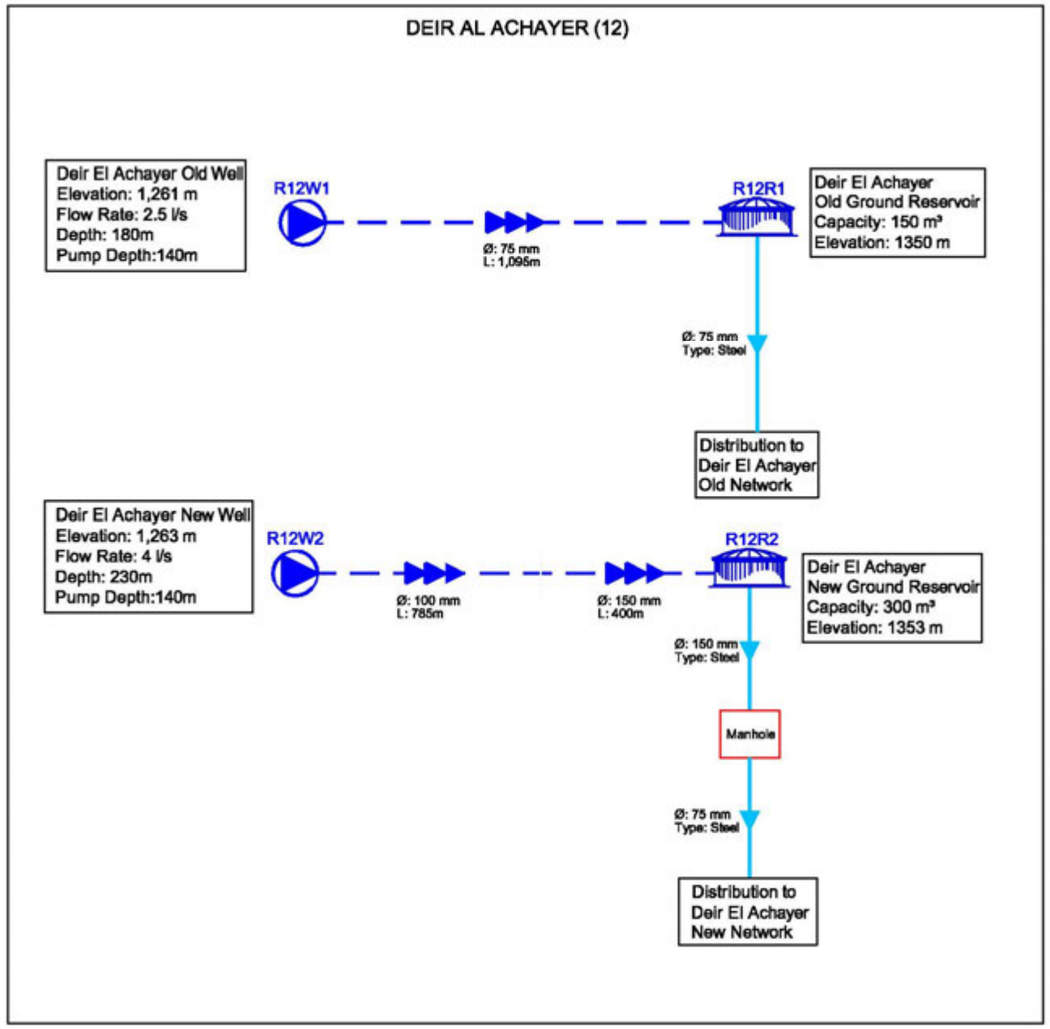
Spring R11S1: Spring dries during summer season.

Well R11W1: Well is not in service yet due to problems regarding the alignment of its transmission pipe.

Reservoir R11R1 (>10 years; 300 m³): Reservoir is in good condition.

Elevated tank R11ET1 (50 m³): Elevated tank is old but it is in acceptable condition. Its pipes are rusted and need to be changed. This elevated tank needs some minor maintenance.

Deir Al Achayer (12)



The existing water network is in very good condition and it has a length of around 9 km. It covers a large area of the town.

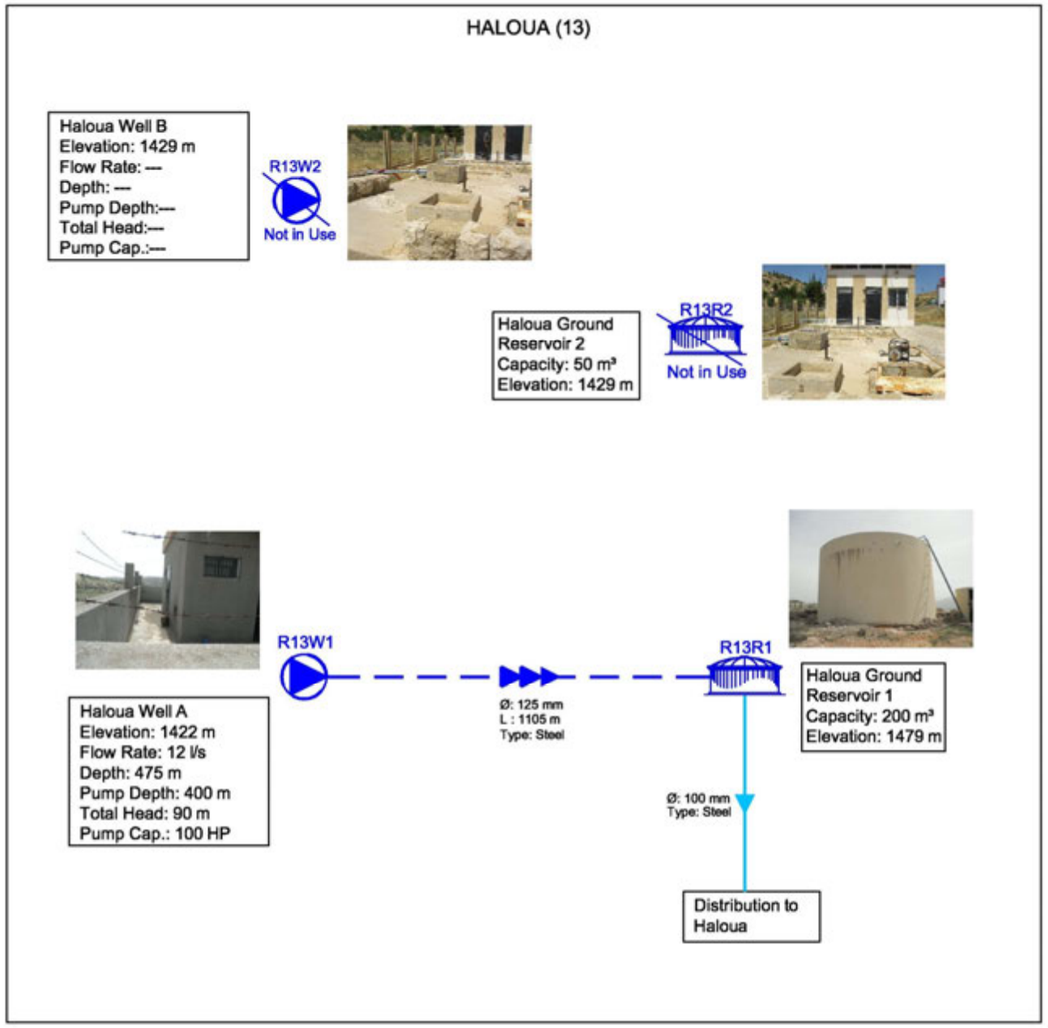
Well R12W1: No available information.

Well R12W2: No available information.

Reservoir R12R1 (150 m³): No available information.

Reservoir R12R2 (300 m³): No available information.

Haloua (13)



The existing water network is in good condition. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

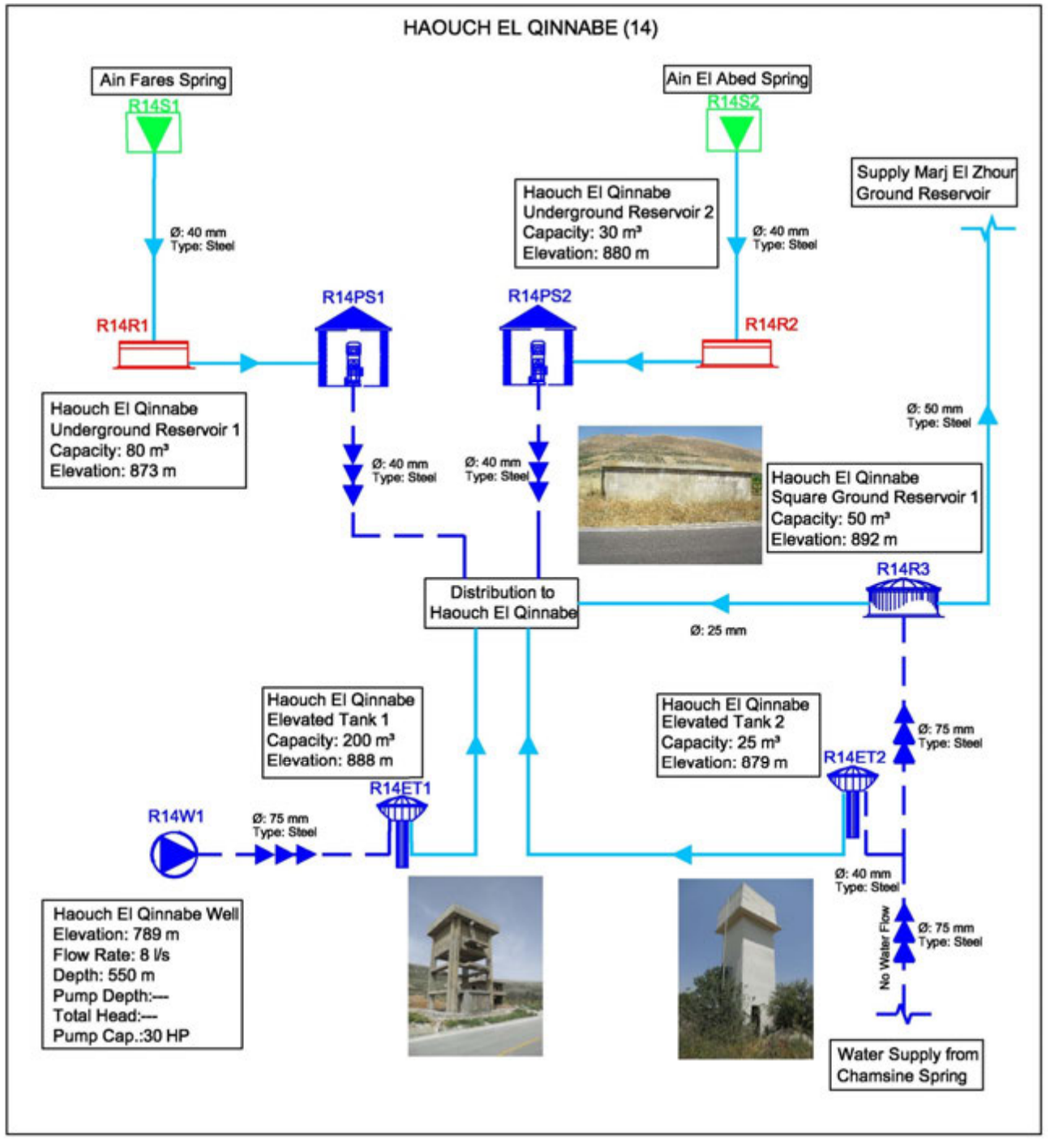
Well R13W1 (25 years old): Well is in bad condition and it suffers from a shortage of electric power. There is no chlorination unit for this well. It needs minor rehabilitation.

Well R13W2: Well is not in use. No more available information.

Reservoir R13R1 (20 years old; 200 m³): Reservoir is in good condition.

Reservoir R13R2 (50 m³): Reservoir is not in use anymore.

Haouch El Qinnabe (14)



The existing water network is old and it is in a bad condition. The only water source in the town is Chamsine spring. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

Well R14W1 (10 years old): Well is not in use yet. Its building is used as a depot for livestock. It suffers from a shortage of electric power.

Spring R14S1 & R14S2: No available information.

Pump station R14PS1 & R14PS2: No available information.

Underground reservoir R14R1 (80 m³): No available information.

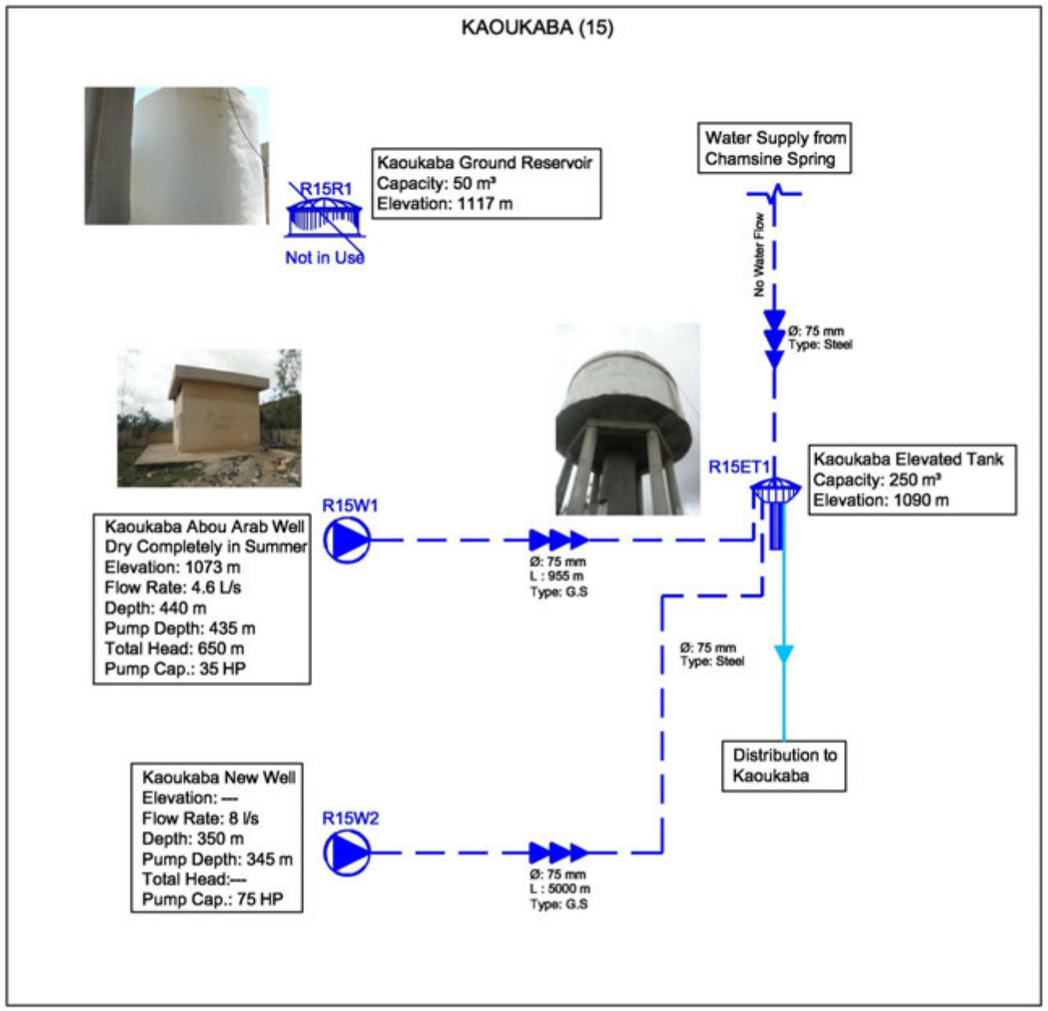
Underground reservoir R14R2 (30 m³): No available information.

Reservoir R14R3 (50 m³): Reservoir is very old and need rehabilitation or reconstruction.

Elevated tank R14ET1 (200 m³): Reservoir was still under construction during visit time. It needs to be painted and the missing pipes shall be installed.

Elevated tank R14ET2 (25 m³): Reservoir is very old but it still in acceptable condition. Some rusted pipes need to be changed.

Kaoukaba (15)



The existing water network is in very good condition and it has a length of around 14.3 km. It covers a large area of the town. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

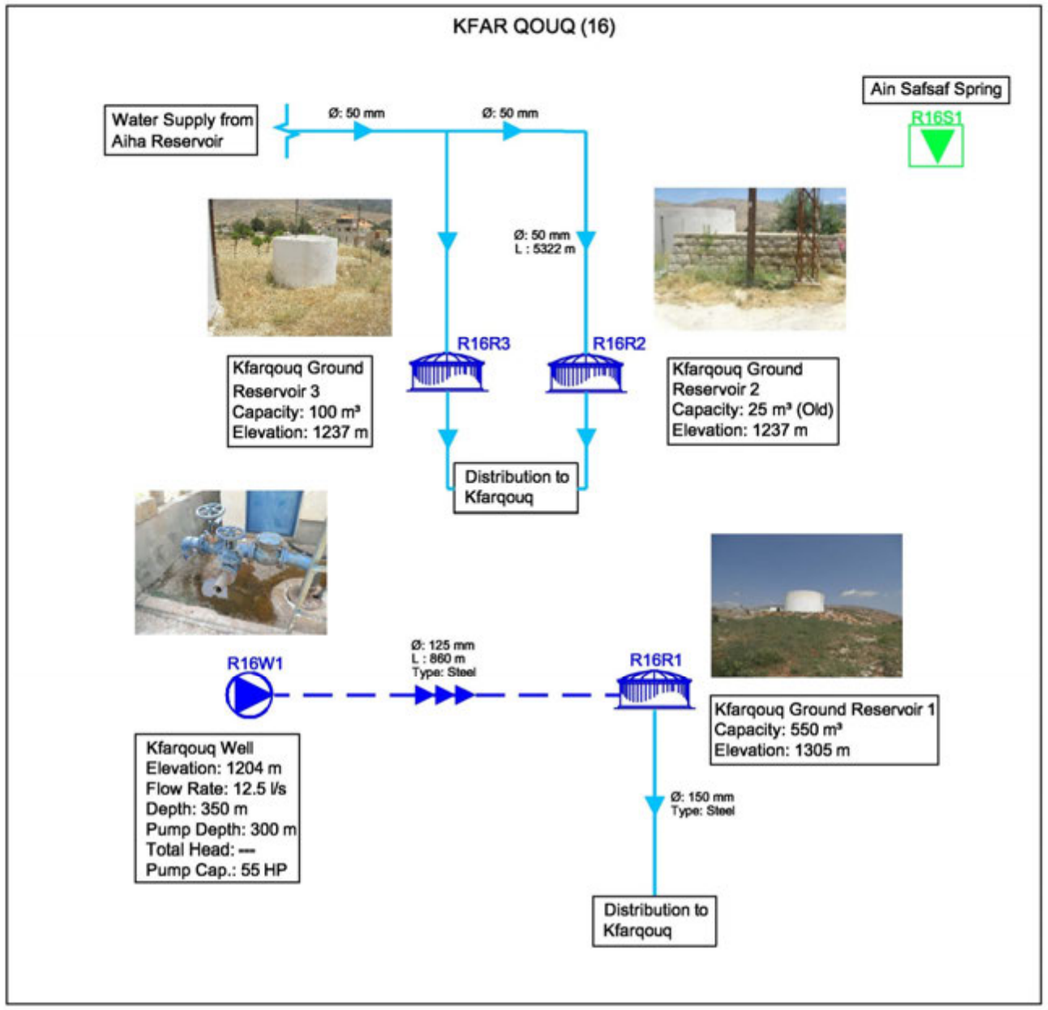
Well R15W1 (20 years old): Well is old, and it dries each summer. The centrifugal pump is broken but the submersible pump is operational. This submersible pump fills a small tank (16 m³) located near the well in one hour. Its electrical panel is not working.

Well R15W2 (< 2 years old): Well is new and it is in good condition.

Reservoir R15R1 (20 years old; 50 m³): Reservoir is not in use. It is old and needs some rehabilitation.

Elevated tank R15ET1 (250 m³): Reservoir is in good condition. It needs esthetical rehabilitation and some minor maintenance.

Kfar Qouq (16)



There is no available information concerning the water network of the town. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

Well R16W1 (15 years old): Well is old. Some pipes are rusted. This well doesn't have a direct water outlet. It doesn't have a chlorination unit nor a booster pump. It has a private generator but it is used only for emergency. This well needs rehabilitation.

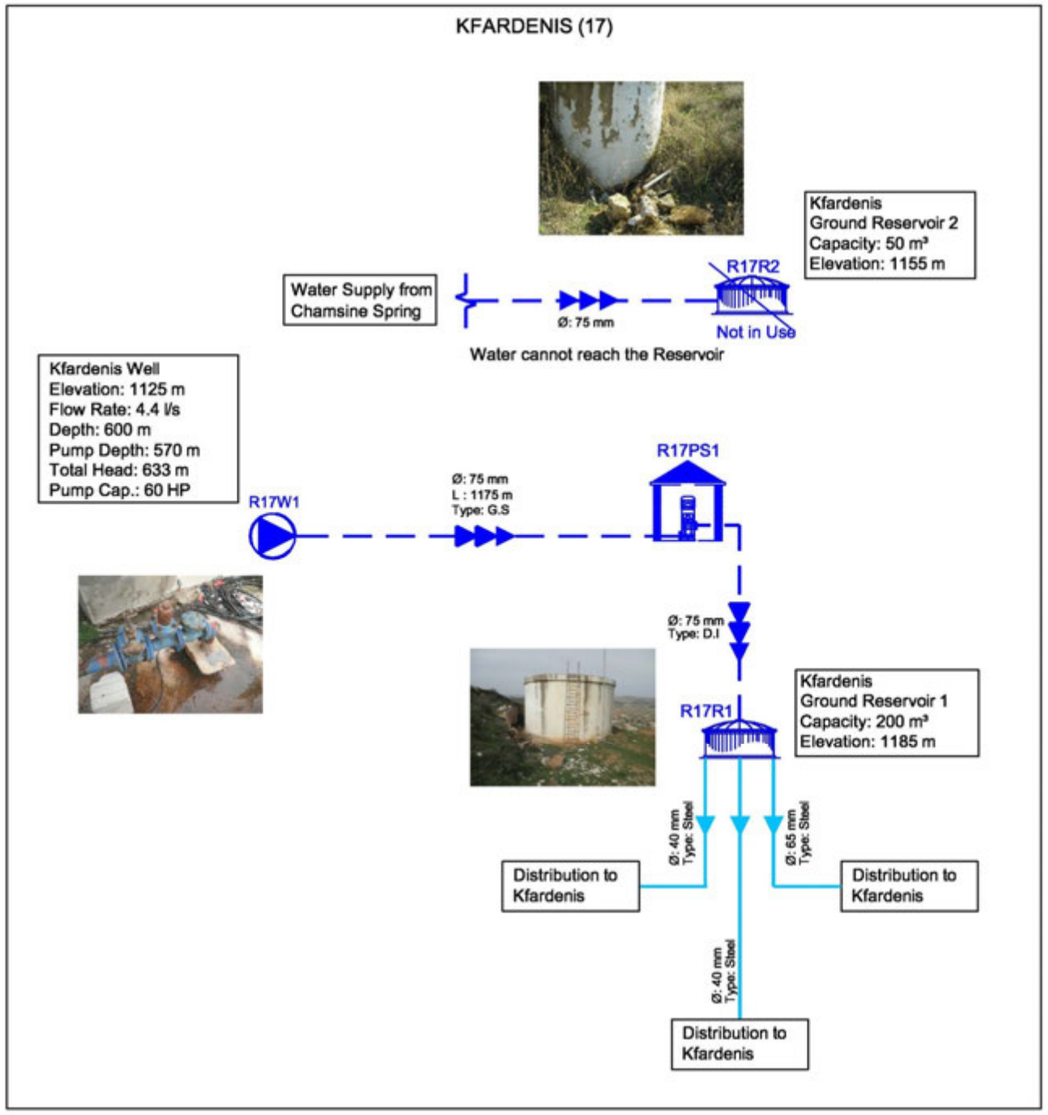
Spring R16S1: No available information

Reservoir R16R1 (15 years old; 550 m³): Reservoir is old but it is in acceptable condition. It is subjected to leakage inside its valves chamber. Some pipes need to be changed. This reservoir needs some minor rehabilitation.

Reservoir R16R2 (25 m³): Reservoir is very old it needs reconstruction.

Reservoir R16R3 (100 m³): Reservoir is in acceptable condition. It needs some minor maintenance concerning its pipes.

Kfardenis (17)



The existing water network is in very good condition and it has a length of around 16 km. It covers a large area of the town. It covers around 75 % of the town. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

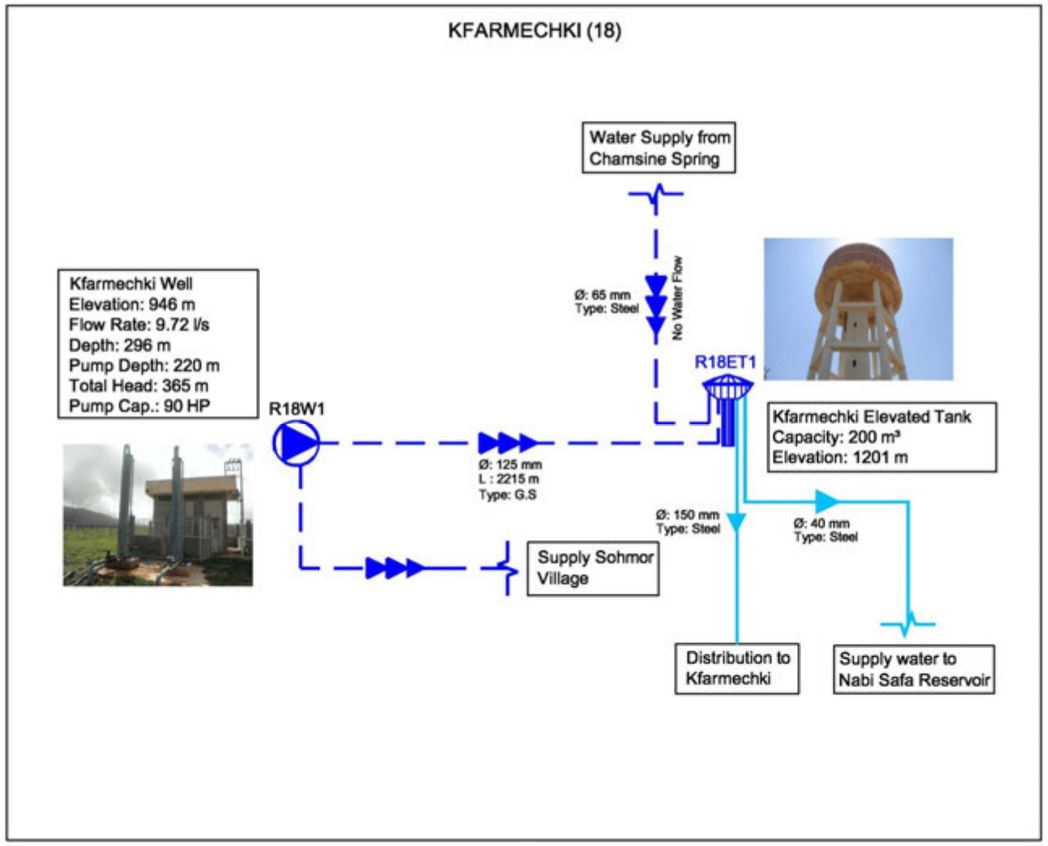
Well R17W1 (15 years old): Well is old. Its valves and pipes are subjected to leakage. This well doesn't have a chlorination unit. Some valves are missing. It needs some rehabilitation.

Pump station R17PS1: No available information.

Reservoir R17R1 (>15 years; 200 m³): Reservoir is not in bad condition. It doesn't have an overflow pipe. Its valve chamber is submerged with water. This reservoir needs some minor rehabilitation.

Reservoir R17R2 (50 m³): Reservoir is very old and it is in bad condition. It is not in use and it needs reconstruction.

Kfarmechki (18)

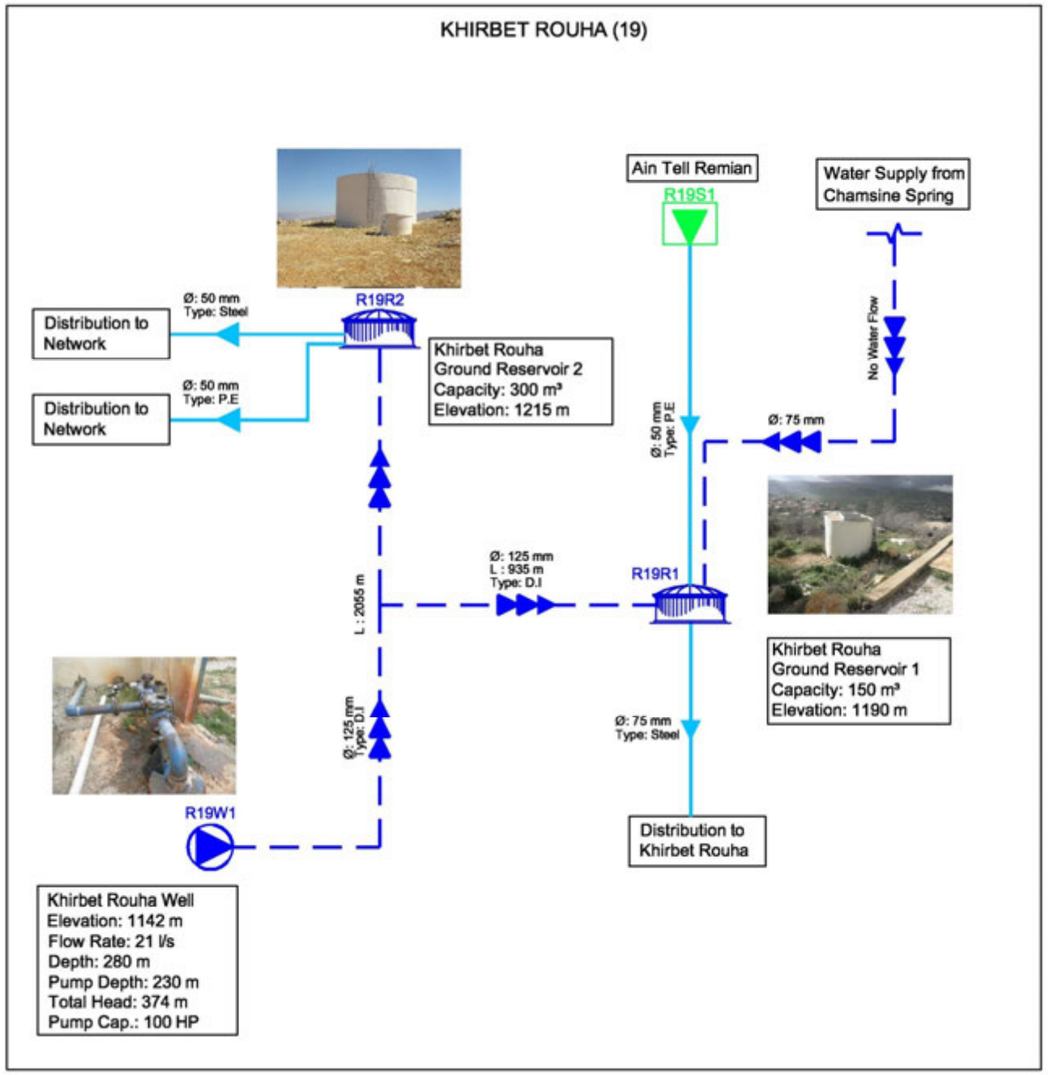


The existing water network is old (installed 20 years ago) and it is in bad condition. A new network is under construction. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

Well R18W1 (>15 years): Well is in good condition. There is no chlorination unit in this well. It has two booster pumps: one of them supplies water to Kfarmechki elevated tank (110 Hp) and another one supplies water to Sohmor village (80 Hp). This well needs minor rehabilitation.

Elevated tank R18ET1 (10 years old; 200 m³): Reservoir is old but in good condition. It needs some minor maintenance.

Khirbet Rouha (19)



The existing water network is in very good condition and it has a length of around 38 km. It covers a large area of the town. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

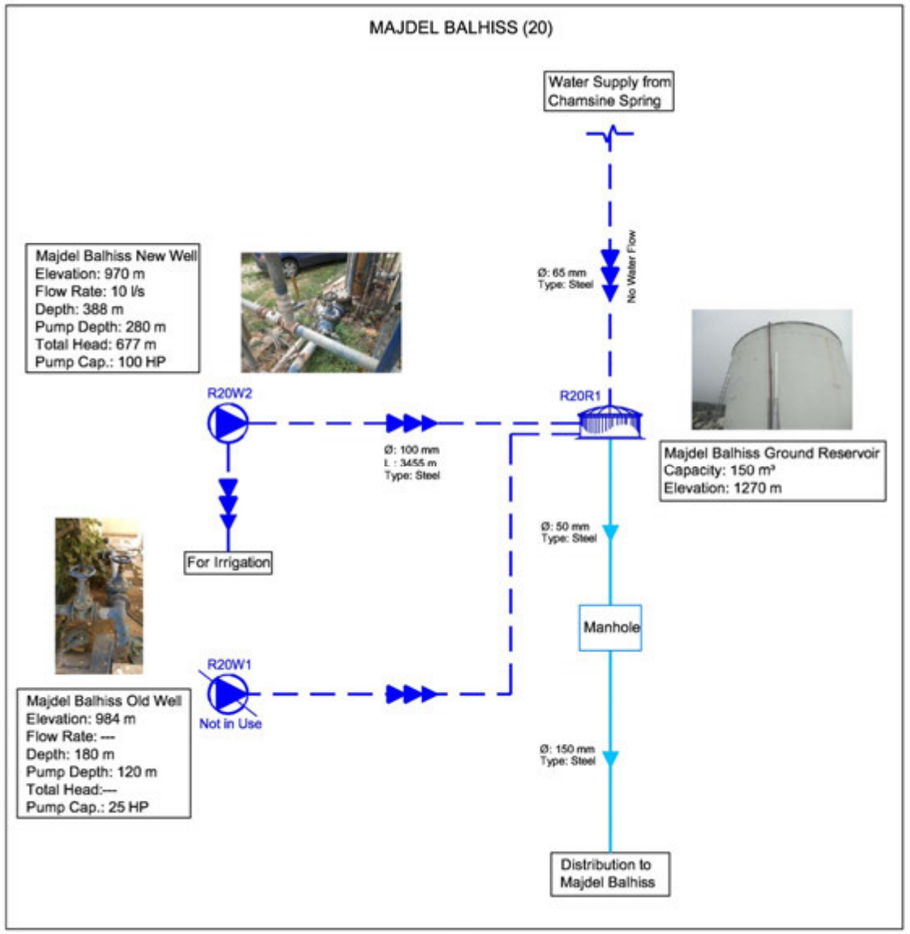
Well R19W1 (15 years old): Well is not in bad condition; however, its chamber needs rehabilitation. This well has no chlorination unit.

Spring R19S1: No available information.

Reservoir R19R1 (45 years old; 150 m³): Reservoir is old but it is in good condition. Its valve chamber is subjected to leakage. This reservoir with its valve chamber needs minor maintenance.

Reservoir R19R2 (300 m³): Reservoir is new and in good condition. Its valve chamber is subjected to leakage. The valve chamber needs maintenance.

Majdel Balhiss (20)



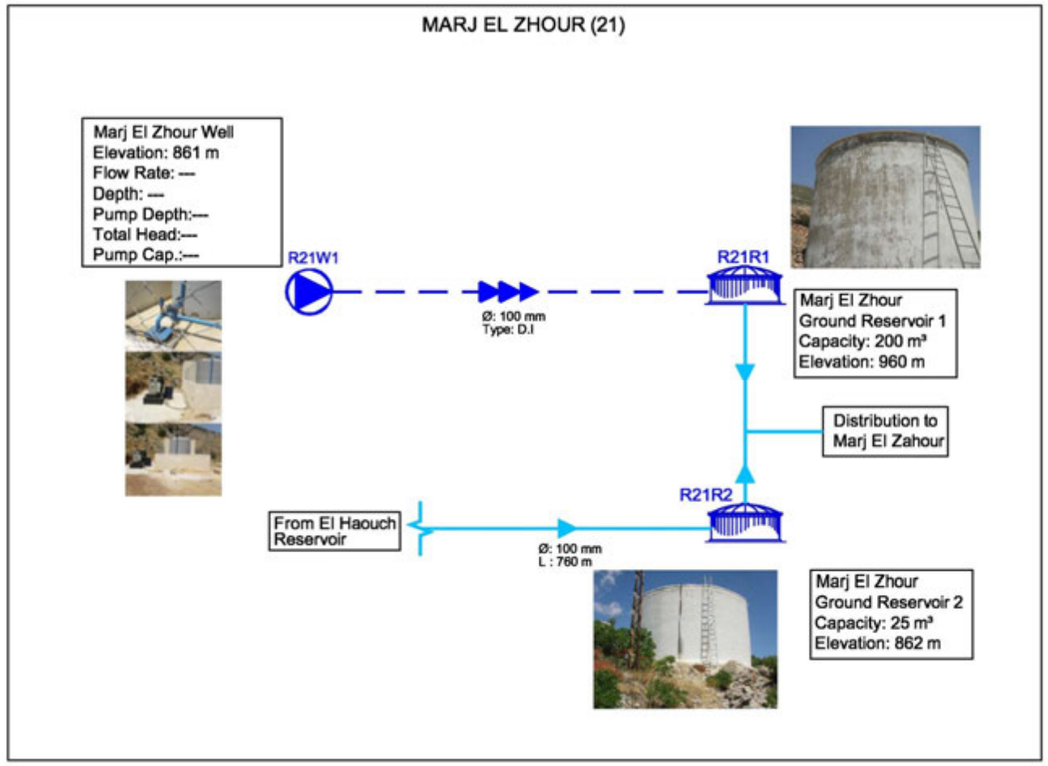
The existing water network is in very good condition and it has a length of around 12 km. It covers a large area of the town. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

Well R20W1 (>20 years): Well is not in use. There is no enough water to pump.

Well R20W2 (>10 years): Well is in acceptable condition. It doesn't have a chlorination unit.

Reservoir R20R1 (55 years old; 150 m³): Reservoir is old but it is in good condition. It is subjected to leakage and its capacity is not enough to supply water needs of the entire town. This reservoir with its valve chamber needs minor maintenance.

Marj El Zhour (21)



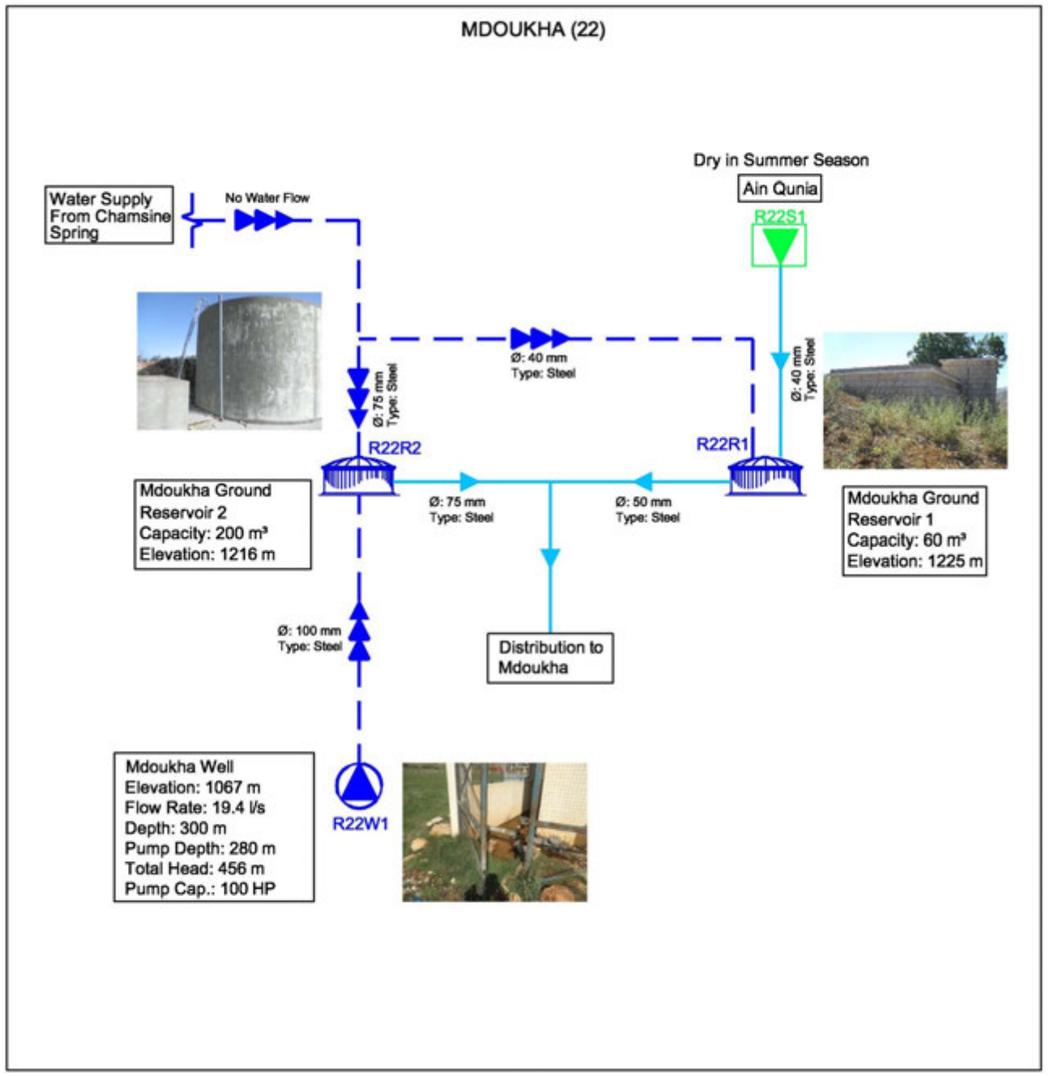
There is no available information concerning the water network of the town.

Well R21W1: No available information.

Reservoir R21R1 (15 years old; 200 m³): Reservoir is old. The ladder is broken which make the roof inaccessible. No more available information.

Reservoir R21R2 (25 m³): Reservoir is old but it is in acceptable condition. It needs some minor maintenance.

Mdoukha (22)



The existing water network is in very good condition and it has a length of around 10 km. It covers a large area of the town. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

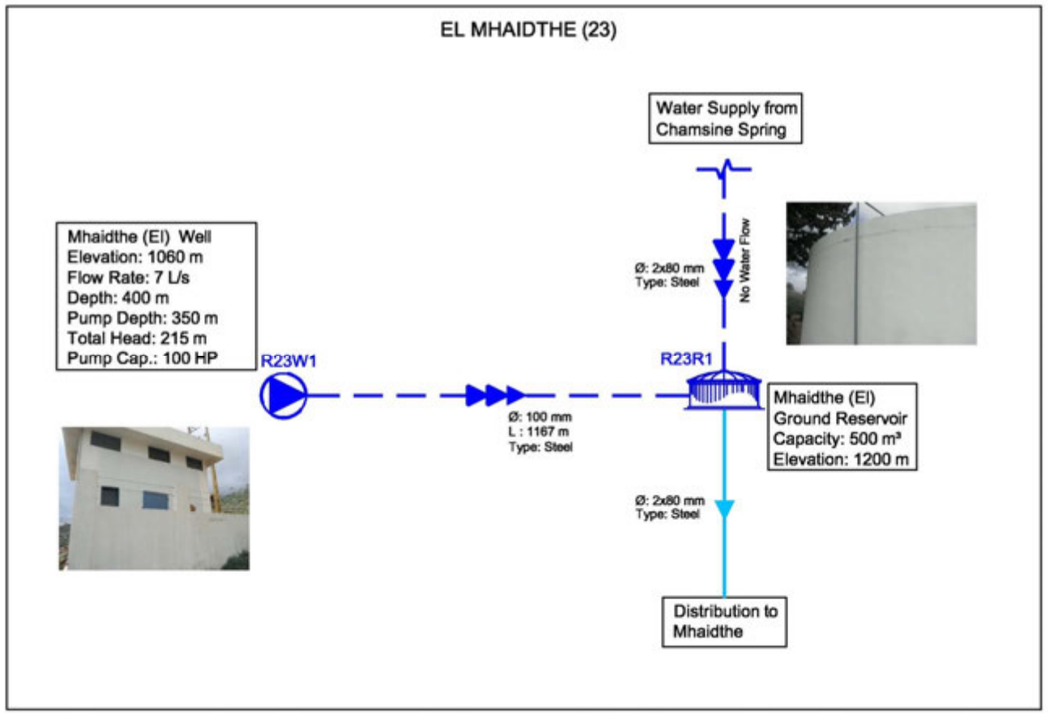
Well R22W1 (>15 years): Well is in bad condition and it suffers from a shortage of electric power. There is no chlorination unit for this well. It has a private generator. This well needs rehabilitation.

Spring R22S1: No available information.

Reservoir R22R1 (20 years old; 60 m³): Reservoir is old and it is in bad condition. It needs rehabilitation or reconstruction.

Reservoir R22R2 (200 m³): Reservoir is old but it is in good condition. Its valve chamber is submerged with water. It needs some minor maintenance.

El Mhaidthe (23)

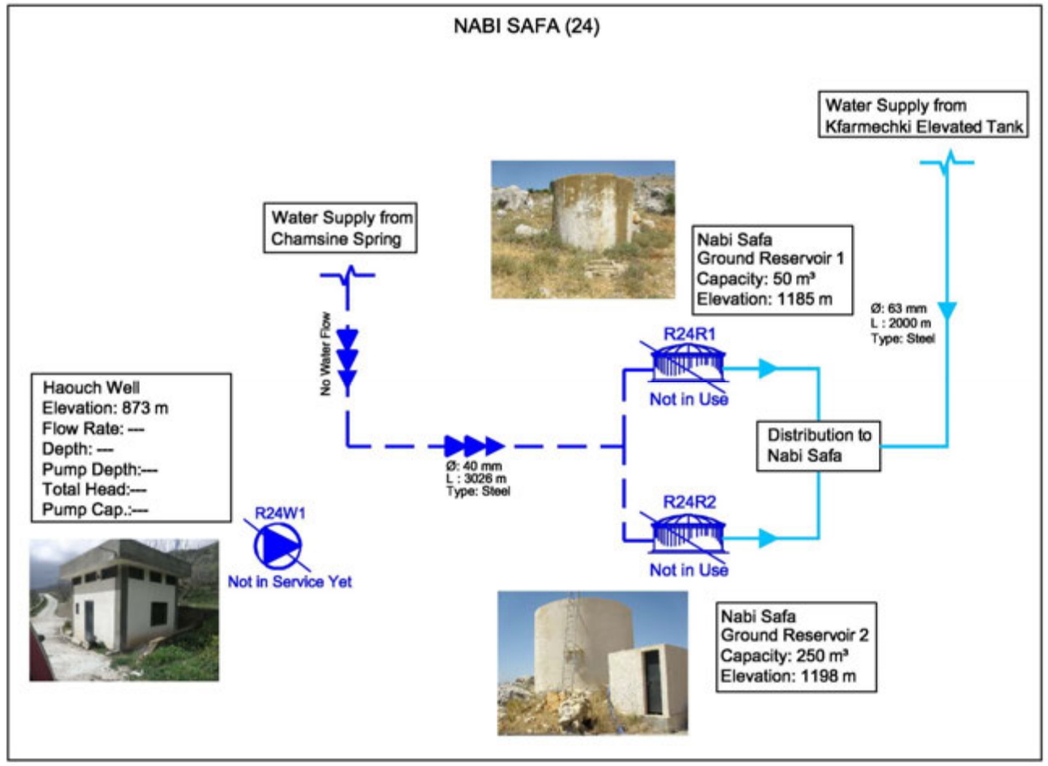


The existing water network is in very good condition and it has a length of around 16 km. It covers a large area of the town a new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

Well R23W1 (15 years old): Well is in bad condition. There is a chlorination unit but it is not in use. It needs rehabilitation.

Reservoir R23R1 (25 years old; 500 m³): Reservoir is in good condition. Its cover is broken. Also the cover of the valve chamber is broken and it is subjected to leakage. This reservoir needs some minor maintenance.

Nabi Safa (24)



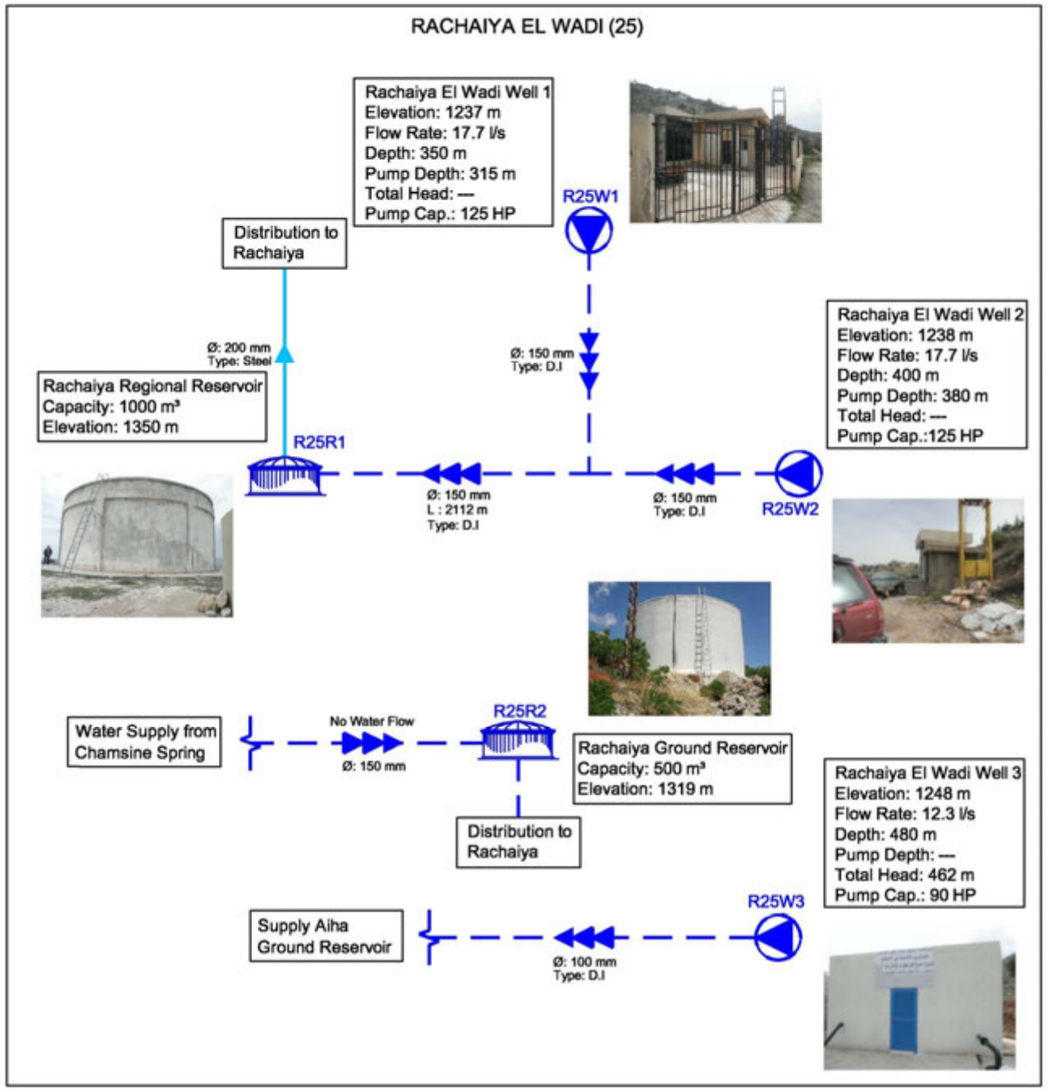
There is no available information concerning the water network of the town.

Well R24W1: It is not in use.

Reservoir R24R1 (50 m³): Reservoir is very old but it is still in use. It needs rehabilitation or reconstruction. This reservoir is not in use anymore.

Reservoir R24R2 (250 m³): Reservoir is in good condition but it is not in use anymore.

Rachaiya El Wadi (25)



The existing water network is in very good condition and it has a length of around 32.5 km. It covers a large area of the town. Lately, it is subjected to some rehabilitation. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

Well R25W1 (20 years old): Well equipment are new and well is in good condition. There is a chlorination unit but it is not in use.

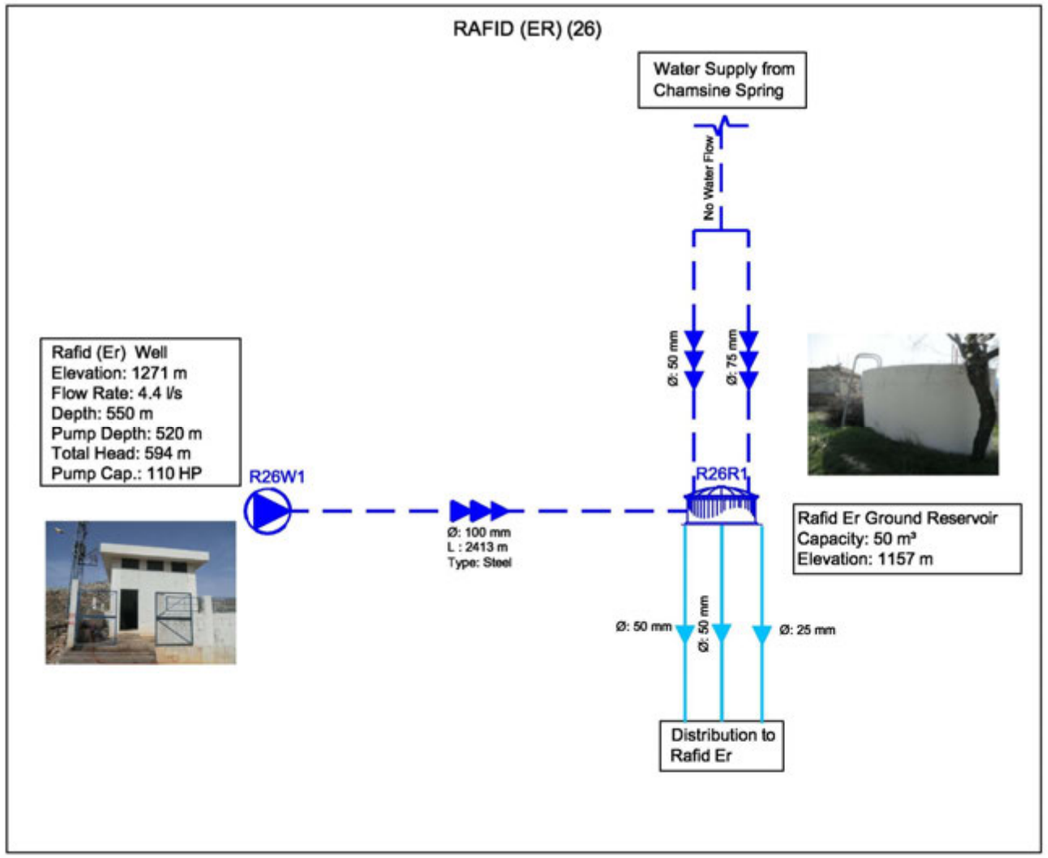
Well R25W2 (15 years old): Well is in acceptable condition. There is a chlorination unit but it is not in use because water is portable. It doesn't have a power generator. It has a booster pump with a capacity of 50 Hp but it is old and need to be changed. Well building needs some rehabilitation.

Well R25W3 (>5 years): Well is new and in good condition but it is not working yet due to some problems between the contractor and consultant. There is no direct water outlet.

Reservoir R25R1 (20 years old; 1000 m³): Reservoir is in acceptable condition. Its pipes are rusted. This reservoir needs some minor rehabilitation.

Reservoir R25R2 (500 m³): No available information.

Rafid (er) (26)

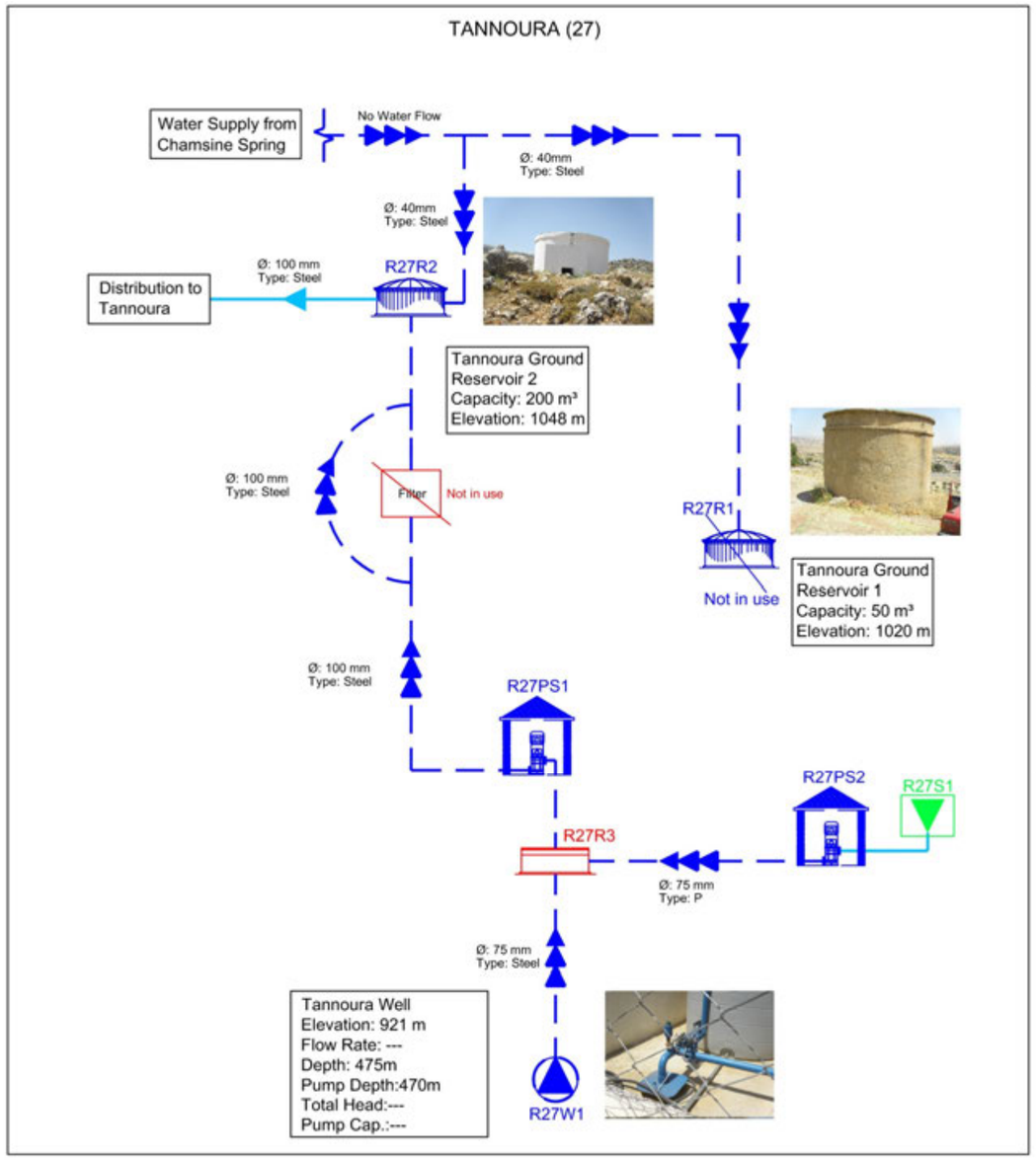


The existing water network is in very good condition and it has a length of around 25 km. It covers a large area of the town. Lately, it is subjected to some rehabilitation. A new line coming from Jabal Al Arabi regional reservoir will supply this village once Ain El Zarqa system becomes operational. The specific layout could not be obtained.

Well R26W1 (15 years old): Well is in acceptable condition. There is a new chlorination unit for this well and its outlet pipe is subjected to rust. The pump of this well is new.

Reservoir R26R1 (>55 years; 50 m³): Reservoir is in good condition. Its flow meter is broken. It needs some minor maintenance.

Tannoura (27)



The existing water network is in very good condition and it has a length of around 9 km. It covers a large area of the town. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

Well R27W1 (10 years old): Well is new and it is in good condition. It has a new generator but it suffers from a shortage of electric power.

Spring R27S1: No available information.

Pump station R27PS1: No available information.

Pump station R27PS2: No available information.

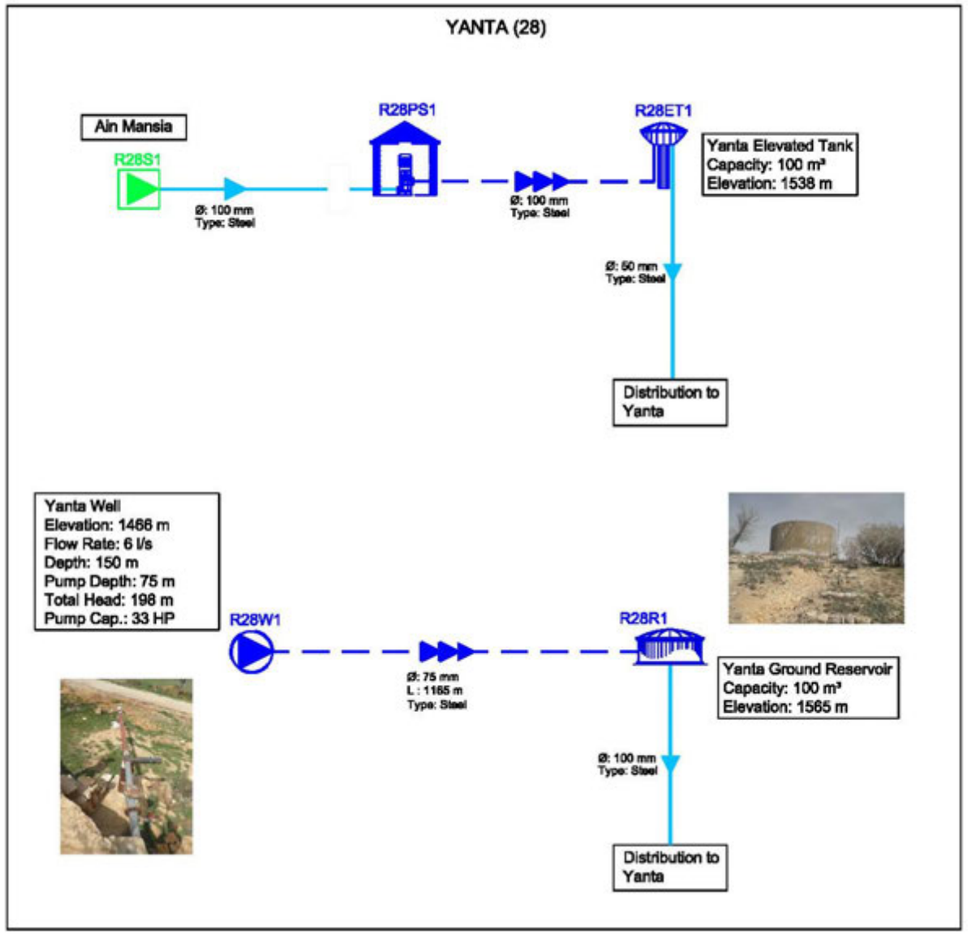
Reservoir R27R1 (50 m³): Reservoir is very old and it is in bad condition. This reservoir is not in use. It needs rehabilitation or reconstruction.

Reservoir R27R2 (200 m³): Reservoir is in good condition but it is subjected to leakage. It needs some minor rehabilitation.

Underground reservoir R27R3: Reservoir is used to store water coming from well R27W1. No more available information.

A filter exists in the town but it is not in use and it is by-passed by a pumping line towards reservoir R27R2.

Yanta (28)



The existing water network was installed 15 years ago and it is not in acceptable condition. A new line coming from Ain El Zarqa spring will supply this village once the system becomes operational. The specific layout could not be obtained.

Well R28W1 (20 years old): Well is in acceptable condition. There is no chlorination unit for this well. It has a generator but it's not working. It needs some minor maintenance.

Spring R28S1: No available information.

Pump station R28PS1: No available information.

Elevated tank R28ET1 (30 years old; 100 m³): No available information.

Reservoir R28R1 (100 m³): Reservoir is in acceptable condition. It needs esthetical rehabilitation.

7 CONCLUDING REMARKS

During the past several months, a data collection campaign was carried out to gather all existing studies and reports that have been prepared regarding water transmission, treatment, storage, and distribution in the Bekaa. This campaign encompassed various activities including but not limited to: extensive meetings with the CDR, mew, BWE and other authorities; written questionnaires sent to 146 municipalities which included questions about the water source and the existence of a water network and its status; a phone campaign to municipalities to obtain information not answered in the questionnaires and request a copy of the existing water map wherever present; and a physical and operational assessment of water treatment plants and water facilities through an extensive site visits program. Based on this campaign, the following is noted:

1- The data regarding the water conveyance situation is scattered and deficient.
2- Most municipalities were not cooperative in providing any information and none but one provided a map of the existing water network.
3- About half the Bekaa localities (70% corresponding to 93% of the population as shown in figures 7-1 and 7-2) actually do have a water network, but only for a part of those is the network in good condition. Some are operational but in bad condition while others are not functional. The information concerning the network condition was inferred from their date of construction, whether they are in use or not, and the municipalities' description of their status.
4- Physical losses from the networks are due to leaks and bursts in the pipelines generated by poor maintenance and old age. Solutions to this problem include leak detection programs followed by maintenance or partial renewal of the system. Such programs have never been systematically implemented in the Bekaa.
5- The CDR is planning or executing a water network for some areas in the Bekaa (5% of the villages corresponding to 2% of the population) that are either un-served currently or have an old and deficient network. However these efforts are limited in reach and inequity in the provision of water supply remains an important issue. The best served areas until now are large agglomerations such as: Baalbeck, Laboué, Aarsal, and Britel in The caza of Baalbeck; Zahle, Bar Elias, Aanjar/Haouch Moussa, and Majdel Aanjar in the caza of Zahle, Hermel in The caza of Hermel; Joub Jannine, Kamed El Loz, and Machghara in the Caza of West Bekaa; and Rachaiya in the caza of Rachiya.
6- Some areas of the Bekaa remain without any water network, either existing or planned (30% of the villages corresponding to 7% of the population). These localities still rely on private wells or purchased water. They are usually small villages located in remote areas.
7- The water facilities under the responsibility of the BWE include ground reservoirs, elevated tanks, wells, chlorination units, pumping stations, water treatment/distribution plants, and springs. The data regarding these facilities is highly conflicting with each source listing different characteristics for the same facility.
8- The Bekaa reservoirs (including ground reservoirs and elevated tanks) vary greatly in size: 32% have a capacity of less than a 100 m^3, 6 % have a capacity larger than 2000 m^3, also 5 % have a capacity between 1000 and 2000 m^3, and 42 % have a capacity between 100 and 500 m^3, distributed equally between the ranges 100-200 m^3 and 200-500 m^3 (figure 7-3).
9- A comprehensive assessment of the facilities condition has been conducted based on site visits, meetings with BWE staff, and available information from previous studies. As shown in figure 7-4, 39 % of the reservoirs (ground reservoirs and elevated tanks) were found to be in good condition, 11 % need minor improvements, while 39 % need rehabilitation or reconstruction. For about 11 % of the reservoirs, not enough information to conduct an assessment could be gathered. As for the wells, they are divided in two categories, namely functional and non-functional. However, a functional well may need various types of improvements to become efficient as it could be providing water intermittently or insufficiently. Overall, 25 % of the BWE wells are currently non-functional (figure 7-5).

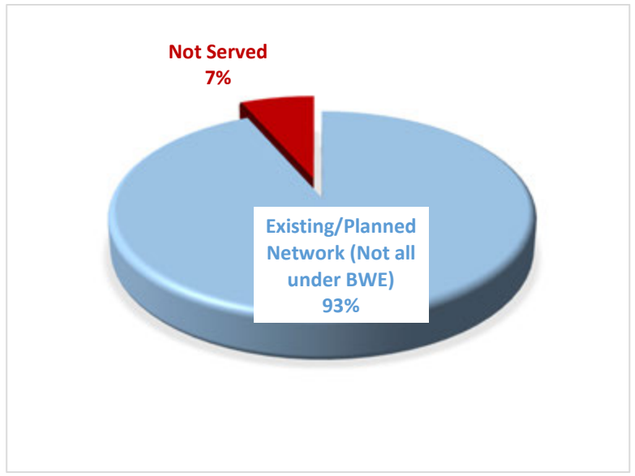


FIGURE 7-1: PERCENTAGE OF POPULATION SERVED BY WATER NETWORKS IN THE BEKAA

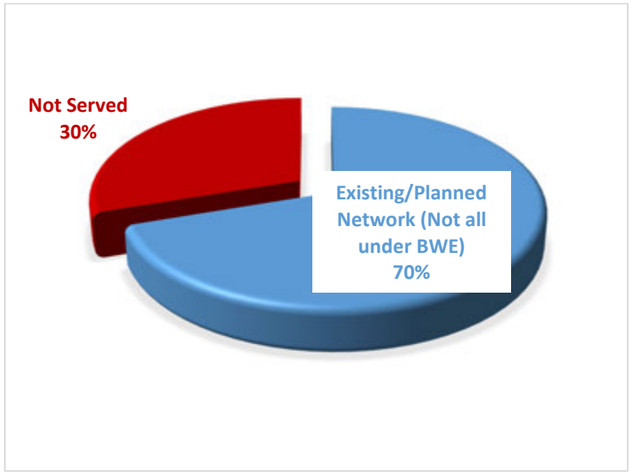


FIGURE 7-2: PERCENTAGE OF VILLAGES SERVED BY WATER NETWORKS IN THE BEKAA

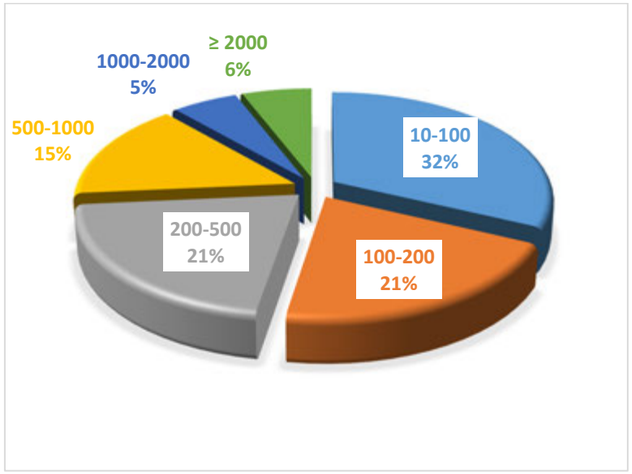


FIGURE 7-3: RESERVOIRS CAPACITY IN THE BEKAA (IN M³)

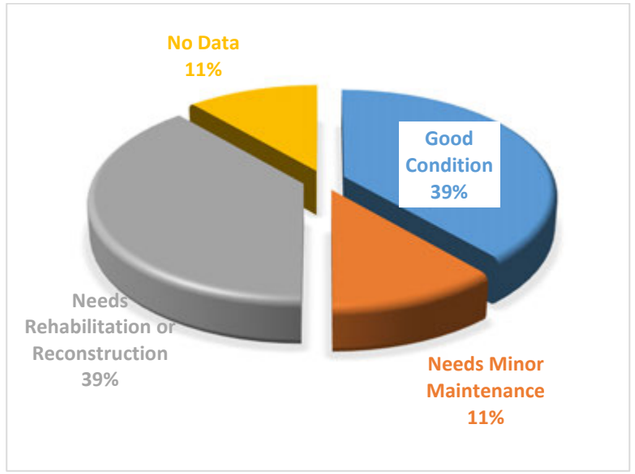


FIGURE 7-4: RESERVOIRS CONDITION IN THE BEKAA

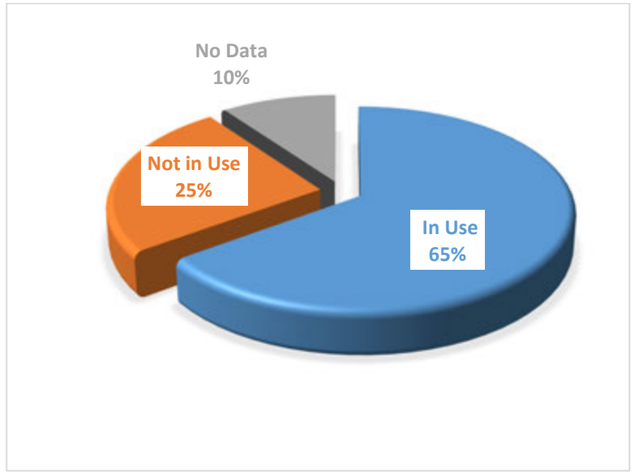


FIGURE 7-5: WELLS STATUS IN THE BEKAA

8 FUTURE TASKS

The next phase of the project will concentrate on making recommendations for improvements to the water supply system. More specifically, the following tasks will be performed:

1- Estimate the current and future water needs based on the population projections for the year 2035 that have been carried out at an earlier stage. The volumes of water needed for every village and by region will be calculated.
2- Attempt to obtain more information regarding the missing network plans. However as this has turned out to be a prohibitively time-consuming endeavor, it will be limited to the few networks that will be deemed essential to the fulfillment of the project objective. As an example, networks that were described as old and not functional by the municipalities will be considered non-existent, and municipalities who declared not having a water network and for which no studies were found for any planned network will be considered not to be served.
3- Formulate a strategy for the selection of the water source in each caza after discussions with BWE/DAI. This should be in agreement with the national water sector strategy which states as its objectives:
    - Maximize the potential of surface water resources;
    - Improve management and protection of groundwater resources, moderate extractions, promote artificial recharge, and consider this resource as a strategic reserve;
    - Fulfill deficits through groundwater and/or surface storage according to potential and availability per region; priority to be given to surface storage in case of availability of both resources.
4- Formulate a strategy for water supply in discussions with BWE/DAI to obtain guidance on issues such as: reliance on large regional systems or small local systems, minimize pumping or not, minimize length of transmission lines or not, average storage time needed, hours of daily supply, etc.
5- Formulate a set of priorities according to which the areas of interest will be identified. These priorities should be set after discussions with the BWE administration so that they take into account the BWE strategic plan. Obtain DAI/USAID approval on these priorities.
6- Based on the set priorities, assess the needs of the identified areas and make recommendations as to the improvements needed. These recommendations will encompass both upgrading of existing networks and facilities wherever applicable and proposing new ones when none exist or where needed.
7- Make recommendations concerning the location, type and size of the water facilities.
8- Present all recommendations in a schedule of Capex and Opex along with their timing.
9- Evaluate funding mechanisms for recommended actions.Z
10- Assess the needed capital investment to achieve system-wide metering across the BWE service area.