

# NATIONAL GUIDELINE FOR RAINWATER HARVESTING SYSTEMS







*Empowered lives.  
Resilient nations.*

# **NATIONAL GUIDELINE FOR RAINWATER HARVESTING SYSTEMS**

**2016**

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## INTRODUCTION

Fresh water is a very precious and rare resource. Water covers 75% of the surface of our planet but only some 2.5% is fresh water and less than 1% is readily accessible for human use, the rest being locked as ice, in biomass or practically out of reach (ref:1).

Currently it is estimated that the available renewable freshwater resources in Lebanon for an average rainy year amount to 4,100 MCM (fig.1) or practically 1000 m<sup>3</sup>/capita/year based on a population of 4.3 million inhabitants not including non-Lebanese residents. This value for water availability is practically equal to the 1,000 m<sup>3</sup>/capita/year water scarcity threshold recognized by UNEP (ref:2).

In other words and contrary to popular belief, Lebanon is approaching the red zone as far as fresh water resources are concerned. The mismanagement of the water sector exacerbates this dire situation which may get worse due to two main factors namely climate change and population increase. The first one may lead to a potential 10-15% decrease in precipitations and an increase of 4-20% in evapotranspiration across Lebanon by 2040 (ref:3), while population is estimated to increase by 30% over the same period (ref:4), ((not taking into consideration non Lebanese residents)). Studies have shown that Lebanon has already experienced an 8% drop in precipitations in Beirut and Tripoli areas (where rainfall records are available) during the last 30 years when compared with earlier periods of the previous century (ref:5).

Because of the relatively low availability and bad governance of its water resources, Lebanon is experiencing extreme water shortages in many regions and is dangerously depleting its

underground water reservoirs up to a point of no return. Consequently, water levels of underground reservoirs are dropping at continuous and alarming rates in many regions of Lebanon and sea water intrusion is observed in most of the coastal aquifers.

This situation does not bode well and is not conducive to a sustainable development of the country.

The *National Guideline for Rainwater Harvesting Systems in Lebanon* is part of a national strategy, outlined in a document that was published in 2010 entitled the "National Water Sector Strategy", aiming to improve water governance in Lebanon with the ultimate goal of preserving our national water resources and using them in a way that is conducive to sustainable economic growth, to healthy social development and flourishing biodiversity.

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**LEBANON  
CANNOT  
PROSPER  
WITHOUT A  
STEADY, SECURE  
AND SAFE  
SUPPLY OF  
FRESH WATER**

RAINWATER HARVESTING DOES NOT ONLY PROVIDE A SOURCE OF WATER THAT INCREASES WATER SUPPLY BUT ALSO IT CAN INVOLVE THE PUBLIC IN WATER MANAGEMENT, MAKING WATER MANAGEMENT EVERYBODY'S BUSINESS.

IT GIVES CONSUMERS A SENSE OF PRIDE AND RESPONSIBILITY

The present document offers detailed guidelines, technical and commercial information on how to size and implement rainwater harvesting systems in rural and urban settings mainly for domestic applications and external uses as applied to residential units, schools, hospitals and any other facility where domestic uses of water are found.

Rainwater Harvesting 'RWH' consists of collecting precipitations falling on roofs, terraces or any adequate surface that can catch water with a view of storing it for later use as prescribed in this document. It has many social, economic and environmental advantages;

- Rainwater being soft water, pipes scaling and corrosion will be drastically reduced, the same could be said for heating equipment like boilers, hot water tanks and solar water heaters.
- Much less quantities of soap and detergents are needed with soft water for washing hands and cleaning cloth thus making economies and reducing the chemical loading of waste water being rejected to nature. Liquid detergent softeners are not required.
- Blending treated rainwater with municipality water will reduce the hardness of the water without necessitating the use of softeners thus sparing the cost of the softener and its operation.
- Users that heavily rely on water trucks will find RWH a blessing, it may simply eliminate the truckloads. Also in the eventual occurrence of water metering in Lebanon at the consumer premises, thus introducing the "pay as you consume principle", rainwater harvesting will definitely reduce the water bill. Rainwater harvesting may easily cut by half the municipality water requirements of a household.
- Rainfall being captured at the source instead of flowing, storm water abatement reduces the possibility of soil erosion and flood risks. This is of particular importance in built up areas

where soil permeability has been practically reduced to nil thus increasing storm water surface flows. Collecting the rainwater will reduce the stress on the municipality storm water network.

- Reduce the load on the water supply network during summer time when water use is at its peak and rainfall is practically nil. This is especially important knowing that Lebanon is increasingly reliant on ground water pumping which gravely impacts water tables levels.

This guideline is intended to be used by all categories of people including those with no technical background. The information is presented in an easily accessible and straightforward way where hopefully the reader will enjoy a stimulating experience to devise and build a rainwater harvesting system that will provide some water supply independence.

The contents are divided into three sections with supporting annexes;

- Section 1** is a birds-eye view of the country with a focus on characteristics that relate to its hydrology as well as other water issues.
- Section 2** introduces the art and science of rainwater harvesting starting with a description of the different components of the system as well as an overall view about the different options and scenarios possible for rainwater use.
- Section 3** offers detailed guidelines how to plan, size, price, implement and maintain a rainwater harvesting system together with tips how to save water. The annexes contain useful information as well as necessary data to perform some of the calculations presented in this section.

## RWH IS AN ACT OF RESPONSIBLE CITIZENSHIP

Rainwater harvesting has been practiced in this region for thousands of years; as the archeological finds in Jbeil and Jericho have shown. Nearer to us in space and time is of course the vernacular architecture of the mountain, as well as that of the urban environment where rainwater harvesting was one of its main features.





Fig.1 Water Budget of Lebanon in a Glimpse (ref:6)

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Typical cube  
configuration  
(House 1)

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## LIST OF ABBREVIATIONS

<b>AGT</b>	Above Ground Tank
<b>cfu/100ml</b>	Colony Forming Units per 100 ml liter
<b>CP</b>	Chlorination Pump
<b>ESMLR</b>	Eastern slopes of Mount Lebanon Range
<b>GWB</b>	Grey Water Blending
<b>HCT</b>	Hypochlorite Chlorination Tank
<b>l/m<sup>2</sup>/d</b>	Liter per square meter per day
<b>LMTA</b>	Lebanon Mountain Trail Association
<b>l/p/d</b>	Liter per person per day
<b>l/shr/d</b>	Liter per shrub per day
<b>MCM</b>	Million cubic meters
<b>m<sup>3</sup>/capita/year</b>	Cubic meters per capita per year
<b>m<sup>3</sup>/d</b>	Cubic meters per day
<b>mg/l</b>	Milligram per liter
<b>MWA</b>	Municipal Water Availability
<b>MWB</b>	Municipal Water Blending
<b>PE</b>	Polyethylene
<b>p/km<sup>2</sup></b>	Persons per square kilometer
<b>PVC</b>	Poly-Vinyl Chloride
<b>RWH</b>	Rainwater Harvesting
<b>RWHCAT</b>	Rainwater Harvesting Categories
<b>RWHS</b>	Rainwater Harvesting System
<b>RWT</b>	Rainwater Treatment
<b>S</b>	Scheme
<b>TDH</b>	Total Discharge Head
<b>TDS</b>	Total Dissolved Solids
<b>TSS</b>	Total Suspended Solids
<b>UGT</b>	Under Ground Tank
<b>UNDP</b>	United Nation Development Program
<b>UNEP</b>	United Nation Environment Program
<b>USAID</b>	United States Agency for International Development
<b>USECAT</b>	Use categorization
<b>WMM</b>	Western Mid-Mountain
<b>WSMLR</b>	Western Slopes of Mount Lebanon Range
<b>WTCAT</b>	Water Treatment Categorization





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# LEBANON, A BRIEF OVERVIEW

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The main purpose of this section is to give a brief summary of the characteristics of the country directly related to Rainwater Harvesting and water availability thus giving the reader some background on and an appreciation of the subject being dealt with.

- 1**  
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WATER REGULATIONS AND WATER QUALITY

# 1 LAND TOPOGRAPHY

Lebanon is located on the Eastern shores of the Mediterranean Sea, it has a nominal area of 10,452 km<sup>2</sup>. The country stretches 225 km lengthwise along a N-NE / S-SW axis with a width tapering from 88 km in the North to 35 km in the South. Its latitudinal span is 33.2 – 34.7 °N while its longitudinal one is 35.2 – 36.6 °E.

Its topography is made up West to East of a coastal plain and two parallel mountain ranges that taper off at both ends, respectively the Lebanon and the Anti-Lebanon separated by an inland plateau, the Bekaa.

The narrow very fertile coastal plain squeezed between the Mediterranean Sea and the Western foothills of the Lebanon Range has a maximum width not exceeding 6.5 km in the North interrupted in few places by the advances of promontories plunging abruptly into the sea as at “*Nahr el Kalb*”.

The Lebanon Range with its highest peak towering above 3000 m in the North has a very abrupt and rugged topography characterized by valleys and deep clefts running East-West perpendicular to its dorsal therefore dividing the range into steep sloped natural bastions that form drainage basins for waterways and springs. The snow- capped ranges of Mount Lebanon at altitudes above 1800 m constitute the open air water reservoirs of the country that feed waterways and underground aquifers long after the rain has stopped. However till the present time, the exact contribution of the snow cover to the water supply of the country has not been well studied and investigated.

The Bekaa Plain, lying at the East of the Lebanon Range is a very fertile High Land about 16 km wide and 129 km long gently sloping from an altitude of 1100 to 900 m from North to South. It is crossed lengthwise along its lower stretch by the Litani river, the most important waterway in Lebanon. The Hermel is the

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northern stretch of the Bekaa plain, it is itself crossed lengthwise by the Orontes river, one of two rivers shared with bordering countries, the other being the Hasbani.

East of the Bekaa stands the Anti-Lebanon Range which separates between Lebanon and the Syrian inland, its highest peak located southward, Mount Hermon, rises to 2860 m. Unlike the Lebanon Range, the Anti-Lebanon is rather thinly populated and vegetated. The Hasbani, a tributary of the Jordan river, is the only perennial waterway in Lebanon having its sources from the Anti-Lebanon.

## 2 CLIMATE AND PRECIPITATION

Lebanon exhibits diverse micro climates with varying amounts of precipitations. It has a rather long dry season extending from April to October and a shorter wet season from November to March characterized by relatively short,

interspersed but heavy downpours. Overall, on an average rainy year, Lebanon receives some 800 mm of rainfall.

Rainfall monthly percentage distribution is practically the same all over Lebanon (Table 1) despite variations in quantities depending on regions (Table 2).

**Table 1.** Average Percentage Distribution Of Rainfall On A Monthly Basis For Lebanon – (Ref:22)

SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
0.7%	6.8%	11.8%	19.9%	22.4%	17.1%	12.9%	6.4%	1.6%	0.3%	0.1%	0.1%

Source: Meteorological data of Lebanon

Practically speaking, around 85% of the precipitations in Lebanon are concentrated over 5 month from November to March. This has profound implications on RWHS and especially in what relates to storage.

Beirut airport. However this is of no serious consequence for the purpose of this document because there is hardly any permanent human settlement in Lebanon above 1900 m altitude. Actually the highest village in Lebanon, Bkaa Kafra in the North, lies between 1600 - 1800 m altitudes.

The littoral and the Western Slopes of Mount Lebanon Range (WSMLR) have predominantly a Mediterranean climate where up to 500 m altitude, average yearly precipitations vary between 800 and 1000mm while at higher altitudes up to 1800 m average yearly rainfall may reach 1400 mm (Dahr el-Baidar, Qartaba). Generally, rainfall increases on the WSMLR at the rate of 25mm for each 100m elevation.

On average, the littoral and the WSMLR, experience between 60 and 80 rainy days a year and at altitudes above 1200 m, around half that amount of snowy days.

The Eastern slopes of Mount Lebanon Range, the Bekaa plain and the Anti-Lebanon Range have more of a continental climate being less exposed to the dampening effect of the Mediterranean. The average yearly rainfall in the Bekaa plain varies in increasing intensity from North to South. It ranges from 450 mm (Haouch Snaid) to 1000 mm (Khorbet Kanafar) while the Hermel area which lies at the northern extremities of the Bekaa plain experiences a rather arid climate with average yearly rainfalls not exceeding 250 mm. Baalbeck itself which is the southern gateway to the Hermel receives an average of 450 mm.

There are no precise precipitations data at altitudes higher than 1800 m because the available measuring equipment is not adapted to snowy and cold weather according to the meteorological service at

There are no readings for the Anti-Lebanon which receives together with the Hermel area the least amount of rain, however some areas in the Wadi el Taym corridor which lies at the foothills of

the Anti-Lebanon at the level of the southern Bekaa plain still receive some 1000 mm of rainfall (Hasbaya, Kfair ez-zayt).

**Table 2.** Average Rainfalls For Selected Regions Of Lebanon – (Ref:22)

Region	Rainfall (mm/year)
Beirut	710
Littoral North up to 500 m altitude	745
Littoral Center up to 500 m altitude	850
Littoral South up to 500 m altitude	655
WSMLR 500 – 1200 m	1200
WSMLR 1200 – 1800 m	1100
Bekaa North	450
Bekaa Center	690
Bekaa South	870
Litani basin	718
Orontes basin	450
Yammouneh	1000
Hermel	250
Wadi el Taym	917

Source: Meteorological data of Lebanon

Predominant winds in Lebanon blow in a West/South-West direction for most of the year, Easterlies and Northern winds are of lesser occurrence but of significant effect especially Easterlies that bring sandstorms from the Syrian inland and Arabian peninsula during spring and less frequently in summer and autumn.

The winds do have an impact on RWHS as far as rainfall water quality is concerned as shown further below.

Precipitations in Lebanon could have drastic annual variability; in some regions inter-annual variability may exceed 500% between exceptionally rainy and dry years. The year 2014 is a good example of a dry year where average precipitations on the national soil were nearly half the annual average knowing that this year is not the worst that Lebanon has experienced or will probably experience in the future.

On average, rainfall events in Lebanon rarely exceed 10 days, the weighted average being around 1.5 days. Moreover rainfall event exceeding 4 days rarely occur more than once a year. Basically, heavy rainfall events in Lebanon are characterized by their brevity and intensity which is typical of a Mediterranean climate. It is not uncommon for daily rainfalls to reach 200 mm at mid altitudes or 100 mm at the littoral.

On average, one rainy day out of 10 receives more than 30 mm of rainfall in the coastal region and 45 mm at mid altitudes, while around half of the rainy days on the national territory yield less than 5 mm. Overall heavy rainy days that yield rainfalls in excess of 40 mm do not exceed 20% of rainy days over any one year.

Rainfall recording started in Lebanon some 137 years ago at the meteorological observatory of the American University of Beirut. Since then many stations were added over the years to cover most areas of Lebanon and some even in Syria. By 1975 some 146 stations were more or less operational but this number quickly diminished at the onset of instability during that year. Practically only three stations kept operating namely Beirut airport, Ksara in the Bekaa and Tripoli. Thus only these stations have complete recording series that extend over relatively long periods of time.

Starting in the 1990s, some more existing stations were recording again and new stations were put into service, currently 39 stations are operational with more being planned. The stations listing are as shown in Annex B.



### 3 POPULATION

With a current population of some 4,200,000 inhabitants yielding an occupancy density of around 400p/km<sup>2</sup>, Lebanon is one of the ten most populated

countries in the world if small entities like the Vatican state and Honk Kong are not taken into consideration. If non-national residents are taken into account, it is one of the five most populated countries in the world.

**Table 3.** Mohafazat Population Growth Over Year 2030 Horizon (Ref:4)

MOHAFAZAT	2000	2030	% Growth
Beirut & Mount Lebanon	1,910,896	2,310,000	21.22
North Lebanon & Akkar	807,204	1,140,000	41.18
South Lebanon & Nabatyeh	747,477	1,040,000	37.93
Bekaa & Baalbeck-Hermel	539,448	740,000	38.90
TOTAL	4,005,025	5,230,000	30.79

Source: NPMPLT, 2005, chapter 2, Table 4

However, the age pyramid of Lebanon is starting to thin out at the bottom a clear indication of demographic maturity and lower future population growth rates (ref:7).

Residents in Lebanon are expected to top 5 million by 2030 (Table 3) with an expected average yearly growth rate of 1 % (ref:4). The most economically developed areas of Lebanon namely Beirut and Mount Lebanon are heavily urbanized while the periphery which is still to a certain extent rural is less so (Table 4).

**Table 4.** Population Distribution Over The Land Horizon 2030 (Ref:4)

MOHAFAZAT	YEAR 2000			YEAR 2030		
	TOTAL POPULATION	POPULATION IN URBAN CENTERS		TOTAL POPULATION	POPULATION IN URBAN CENTERS	
Beirut & Mount Lebanon	1,910,896	1,651,000	86%	2,310,000	1,990,000	86%
North Lebanon & Akkar	807,204	385,000	48%	1,140,000	620,000	54%
South Lebanon & Nabatyeh	747,477	327,000	44%	1,040,000	490,000	48%
Bekaa & Baalbeck-Hermel	539,448	181,000	34%	740,000	300,000	40%
TOTAL	4,005,025	2,544,000	64%	5,230,000	3,400,000	65%

Source: NPMPLT, 2005, chapter 2, Table 6

80% of the residents live on the coastal zone (0-400 m) making out of it one of the most densely populated areas in the world (1310 p/km<sup>2</sup>) as shown in (Table 5).

**Table 5.** Lebanon Population Density As Function Of Altitude (Ref:4)

ALTITUDE RANGE (m)	POPULATION DENSITY (P/Km <sup>2</sup> )	CLIMATE ZONE
0 – 400	1,310	Coastal (Zone 1)
400 – 800	278	Coastal (Zone 1)
800 – 1200	257	WMM (Zone 2) & In-land Plateau (Zone 3)
1200 – 1600	91	WMM (Zone 2) up to 1400 m
1600 – 2000	15	High Mountain (Zone 4)
> 2000	1	High Mountain (Zone 4)

Source: NPMPLT, 2005, (column 3 added), WMM: Western Mid-Mountain

However with the huge influx of people to Lebanon fleeing conflict areas in neighboring Syria most demographic statistics of Lebanon are currently outdated thus requiring major revisions.

It is estimated that the current resident population in Lebanon is around 5.5 million and while this number may increase in the near future depending on the situation in the area, it might not drop down any time soon thus putting increased pressure on water demand.

The effect on water demand caused by the alarming increase in population is even further magnified by the higher living standards sought out by the population as a direct outcome of economic growth and social awareness.

Currently, the average household size in Lebanon is estimated at 4.3 persons, living in around 1 million dwelling units.

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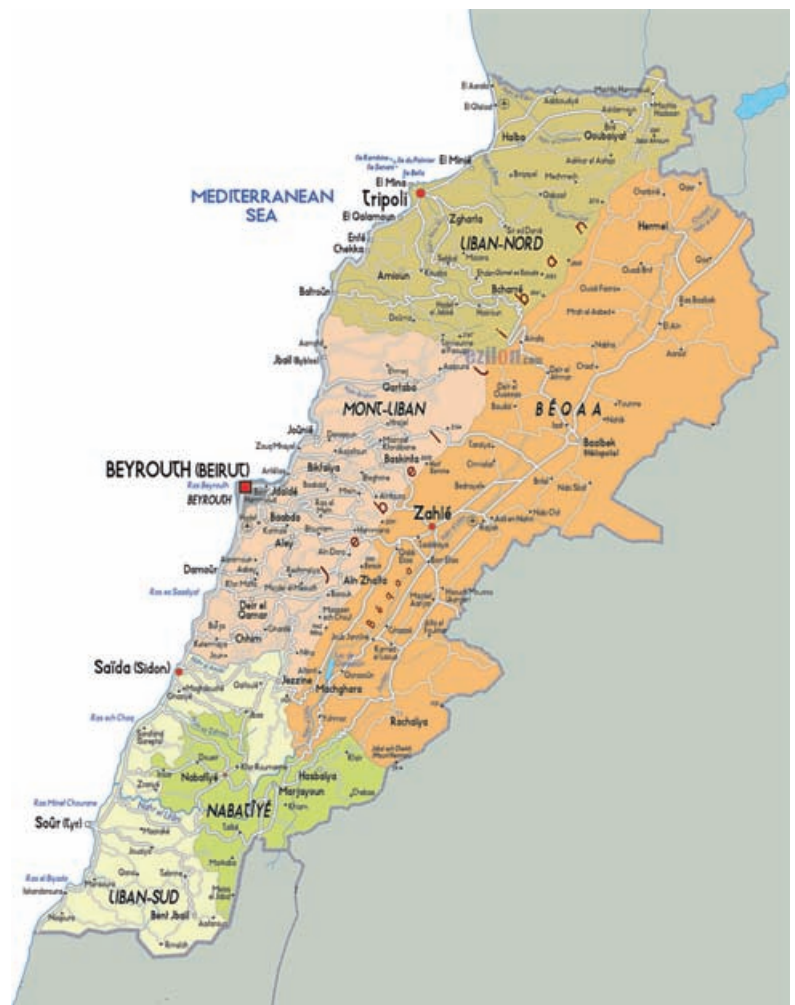
**CURRENTLY, THE AVERAGE HOUSEHOLD SIZE IN LEBANON IS ESTIMATED AT 4.3 PERSONS, LIVING IN AROUND 1 MILLION DWELLING UNITS.**

## 4 ADMINISTRATION

Lebanon is divided into 6 governorates (Mohafazat) namely, North Lebanon, Bekaa, Mount Lebanon, Beirut, Nabatyeh and South Lebanon, divided into a total of 25 districts (caza) themselves composed of municipalities. Beirut has no districts but has a municipality.

With the exception of Beirut, the Mohafazats and their caza extend over several climatic zones thus experiencing different rainfall regimes. Hence, with the exception of Beirut, any one Mohafazat or even caza cannot be characterized by one average rainfall number for the purposes of this guidebook if a minimum of accuracy in the calculations is to be ensured. Consequently rainfall data will be presented at the town and village level.

This is possible because all the meteorological stations in Lebanon are located in or nearby towns and villages, as for agglomerations that are far away, geographical characteristics similar to areas where the meteorological stations are located will be used as proxy. Basically the two parameters that govern such similarity are altitude and topographical locations. Thus for example two villages relatively far apart but having nearly similar altitudes and topographical locations (located on the western side of mount Lebanon range) will experience roughly the same amount of rain fall.



*Fig.2 The Administrative Organization of Lebanon*

## 5 WATER DEMAND IN LEBANON

Agriculture is the largest water consumer; it absorbs some 55% of the water supply. This share is expected to rise to 60% by 2030 (ref:14). The domestic water supply was estimated at 505 MCM for 2010, it is roughly distributed as follows over the different Mohafazat;

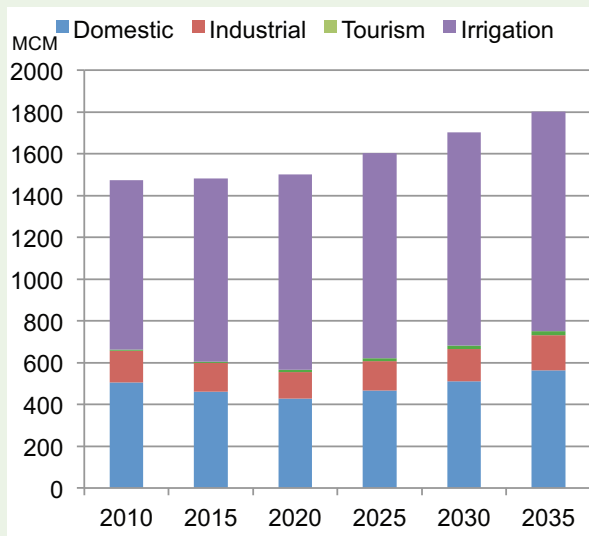


Fig.3 Water Demand (ref:14)

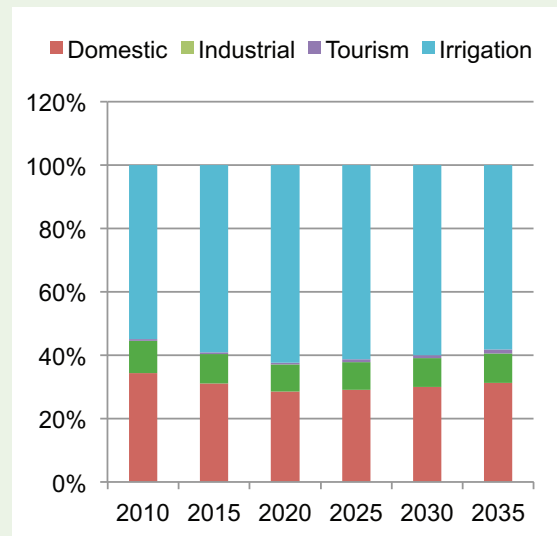


Fig.4 Water Demand as a percentage (ref:14)

It is worthwhile noting that population density and a weak regulatory environment is resulting in serious pollution to water resources which could be considered a form of hidden demand. Actually water supplies that have been polluted could be considered as used water even though they were never physically touched or used by consumers. This is the basic assumption of the water footprint concept.

**WATER DEMAND IN LEBANON IS EXPECTED TO INCREASE BY 250 MCM OVER THE NEXT 20 YEARS WITH IRRIGATION ABSORBING MOST OF THIS INCREASE**



## 6 WATER REGULATIONS AND WATER QUALITY

The regulatory framework regarding water is quite weak in Lebanon. Decree 1039 of 2/8/1999 (ref:18) sets quality requirements regarding the physical, chemical and bacteriological properties for tap water (potable/drinking water not bottled water). These requirements are shown in Annex C of this guideline. (Decree 1039 needs updating...).



There are no standards or regulations in Lebanon concerning rainwater harvesting and the use of rainwater. Consequently, the present guideline document has the objective to set clear requirements regarding the collection, storage, treatment and use of harvested rainwater.

Most of Lebanon's waterways are polluted because of uncontrolled sewage, industrial waste dumping and irrigation water leaching. The most flagrant example is probably the Litani River and Qaraoun Lake which exhibit alarming levels of all sorts of pollution. Tables 6 & 7 give an idea of the extent of pollution in some of the waterways (ref:14).

**Table 6.** Quality Parameters For Selected Rivers In The Dry Season (Ref:14)

River	BOD <sub>5</sub> (mg/L)	NO <sub>3</sub> (mg/L)	TDS (mg/L)	SO <sub>3</sub> (mg/L)	Total Coliform (c/100mL)	E. Coli (c/100mL)
Kabir	14.4	3	270	20	900	20
Bared	28.2	2.8	225	28	610	17
Abou Ali	39.3	3.4	280	22	26,500	3,000
Ibrahim	62.8	1	150	8	3,500	200
Antelias	53.2	3	300	30	28,000	6,000
Damour	21.3	3	200	38	490	15
Awali	33.4	7	210	22	710	1
Qasmieh	22.5	5.5	250	21	80	0
Limit Value	Nil	50	600	250	500	100

Source: STLE, 2010, Table 3.11

**Table 7.** Litani River Basin Water Quality (Ref:14)

Indicator	BAMAS 2005 (Summer)			LRBMS 2010 (summer)			Drinking Water Standard	
	Min	Mean	Max	Min	Mean	Max	Libnor	EPA
<b>Surface Waters</b>								
TDS (mg/l)	88	290.96	706	187	502	1979	<500	<500
pH (pH units)	6.57	7.09	7.68	7.27	7.93	8.66	6.5-8.5	6.5-8.5
BOD (mg/l)	2	48.46	624	2.50	547	1530	NA	NA
Nitrates (mg/l as N)	3	13.46	62	0.10	1.23	4.90	45	<10
Phosphates (mg/l)	0	11.75	197	0	8.58	72	NA	NA
Fecal Coliform (CFU/100ml)	0	223,487	1,500,00	1	71.61	400	0	0
Cadmium (mg/l)	NA	NA	NA	0.005	0.01	0.079		<0.005
<b>Lake Water</b>								
TDS (mg/l)	120	160	196	221	235	256	<500	<500
pH (pH units)	6.5	7	7.5	8.2	8.27	8.32	6.5-8.5	6.5-8.5
BOD (mg/l)	<2	2.57	4	2.0	2.65	3.30	NA	NA
Nitrates (mg/l as N)	16	21	62	0.8	0.93	1.2	45	<10
Phosphates (mg/l)	0.01	0.13	0.35	0	0.09	0.24	NA	NA
Fecal Coliform (CFU/100ml)	0	17	450	0	160	400	0	0
Cadmium (mg/l)	NA	NA	NA	0.0007	0.01	0.021		<0.005

Source: STLE, 2010, Table 3.14

Under a USAID-funded water awareness program, the Lebanon Mountain Trail Association (LMTA) in 2013 analyzed 53 springs located on the LMT, out of 72 springs on the trail. The samples were tested at the North Lebanon WWT lab in Tripoli and the Industrial Research Institute in Hadath. The results showed that 38% of the springs have no bacteriologically contamination, 30% have low to moderate contamination, 15% have moderate to high contamination, and 17% are highly contaminated. Some of the highly contaminated springs are located at higher

elevations (e.g., Ain Bahr in Qehmez, Mount Lebanon, 1604m), an indication that the pollution is also occurring at higher elevations most probably due to septic tanks and discharge into open wells.

Furthermore, over pumping ground wells in coastal areas has dangerously increased their salinity level.



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# RAINWATER HARVESTING AS A VIABLE ALTERNATIVE OPTION FOR WATER SUPPLY

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Rainwater harvesting as scoped in this document is the capture and storage of rainwater for different purposes including domestic use for drinking, bathing, cloth washing, toilet flushing, housekeeping as well as external uses like landscaping irrigation, surface cleaning, hosing and car washing. This guideline is concerned with applications mainly focused on residential units, schools, hospitals, hotels and other facilities where the above mentioned purposes are practiced. It is not meant to deal with large scale irrigation schemes or industrial processes.

This guide book is addressed to all people interested in implementing a RWH system for the targeted applications described above. Consequently, the information is presented in a simple straightforward way that is easy to grasp and implement. The guidebook could be used for implementing rainwater harvesting systems for new projects or as retro-fits for existing projects.

The present section deals in some details with the concepts behind RWH as proposed in this guideline while the next one offers methodologies how to size, price, implement, operate and maintain a RWH system.

1

HOW BEST TO USE RAINWATER IN THE LEBANESE CONTEXT

2

RAINWATER HARVESTING, SYSTEM DESCRIPTION

3

RAINWATER HARVESTING CATEGORIZATION

4

RAINWATER USAGE CATEGORIZATION

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DIFFERENT OPTIONS FOR RAINWATER USE

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11

PLUMBING CIRCUIT CONFIGURATION

# 1 HOW BEST TO USE RAINWATER IN THE LEBANESE CONTEXT

Harvesting rainwater for use during the rainy season is not very advantageous for users connected to the municipality water supply. Usually in winter, municipality water is in abundant supply, it is in summer that water is scarce and has the most economic value. Therefore it is normal to store the rainwater for the lean days. However for users not connected to the municipality network, rainwater supply could be used also during the rainy season which could reduce the storage tank size but this option reduces the strategic water storage during the dry period.

Consequently, this guideline not only recommends the use of relatively large rainwater storage tanks to cater for the dry season water requirements but also the use of separate municipality water storage tanks but of lesser storage capacity as will be shown in the section that follows.

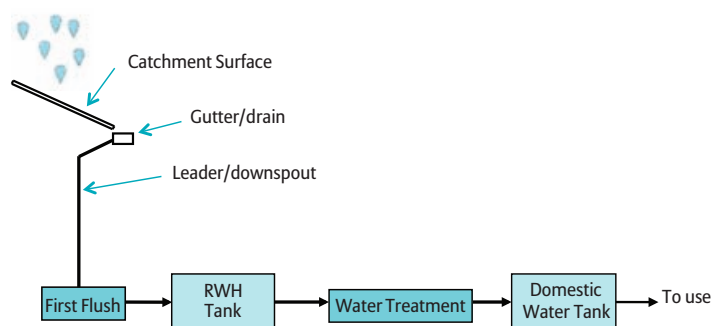
Municipality water should not normally feed the rainwater storage tank, the two systems should be kept separate. It is very important to follow these guidelines to make sure rainwater does not back feed into the municipality water network. This situation may represent a health hazard to all the community connected to the municipality network.

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FOR OPTIMUM WATER RESOURCES USE AS WELL AS FOR SAFETY REASONS, IT IS IMPORTANT TO PROVIDE A MUNICIPALITY WATER STORAGE TANK. THIS TANK WILL ACT AS A PHYSICAL SEPARATION BETWEEN THE MUNICIPALITY WATER FEED NETWORK AND THE RAINWATER SYSTEM.

## 2 RAINWATER HARVESTING, SYSTEM DESCRIPTION

Understanding how the fundamental components of a rainwater system work is crucial when contemplating designing or installing a RWH system.



*Fig.5 General Configuration of a RWH System*

Rainwater harvesting systems comprise three basic components namely:

- **Catchment Surface:** It is the collection surface from which rainfall runs off, it could be the roof of a building, a terrace, a parking pergola roof, a driveway or any area suitable for rainwater collection. The location, construction and exposure of the catchment surface to polluting vectors have a decisive influence on the quality of the rainwater being collected. Hence the less exposed a catchment surface is to atmospheric pollution, human access and use, the lower is the probability of serious pollution being entrained by the rainwater run-off. Thus a roof in a rural area that is not normally accessed will most probably have fewer pollutants than a terrace near an industrial zone or one that is continuously used.
- **Drain system:** Run off water collectors (Drains / gutters) and conveying conduits from catchment area to the storage tank. They could be made of metal or plastic as will be explained in the next section.
- **Storage Tank:** Also called cistern where collected rainwater is stored for future usage. The tank could be located above ground or underground. The tank could be of concrete, plastic or fiberglass. If rainwater quality is an issue for the intended purpose, additional components could be introduced, namely:
- **First Flush tank:** The purpose of this tank is to get rid of the first rainwater for each rain fall event to avoid channeling debris, mud, contaminated particles and other pollution to the rainwater storage tank. As the name implies, the purpose of this tank is to flush the catchment surface before collecting water for storage. Its main advantage apart from improving rainwater quality is to avoid the hassle of manually diverting the collected rainwater to the drain at least at the beginning of the rainy season. However because Lebanon climate is characterized by rain events that are separated by a relatively long stretch of non-rainy days during which the collection surfaces may be subjected to pollution vectors, flushing the first rainwater at each rain fall event is a necessity for higher quality rainwater.
- **Water Treatment:** Its purpose is to improve the quality of the rainwater to expand the range of its use namely for domestic purposes. Water treatment usually includes media and micro-filters, carbon filters, sterilization and domestic water storage tanks. The extent of the water treatment depends upon the end use of the collected rainwater as shown further below.



### 3 RAINWATER HARVESTING CATEGORIZATION

Rainwater harvesting categorization helps expand as much as possible the safe use of rainwater in the Lebanese context. This is so for three main reasons;

1. There are no existing regulations in Lebanon regarding the safe collection and use of rainwater.
2. The consumer has largely no control over rain fall quality.
3. The intent of this document is to maximize the collection and use of rainwater in a safe and rational way, thus to offer the most options and scenarios for rainwater harvesting and the subsequent use of the collected water.

Furthermore the categorization helps consumer acquire a heightened awareness and a more informed approach concerning the safe collection and use of rainwater.

For the purpose of this guideline, four Rainwater Harvesting CATegories (RWHCAT) are defined ranging from highest quality RWHCAT1 to lowest quality RWHCAT4;

1- **RWHCAT1** complies with the following minimum requirements:

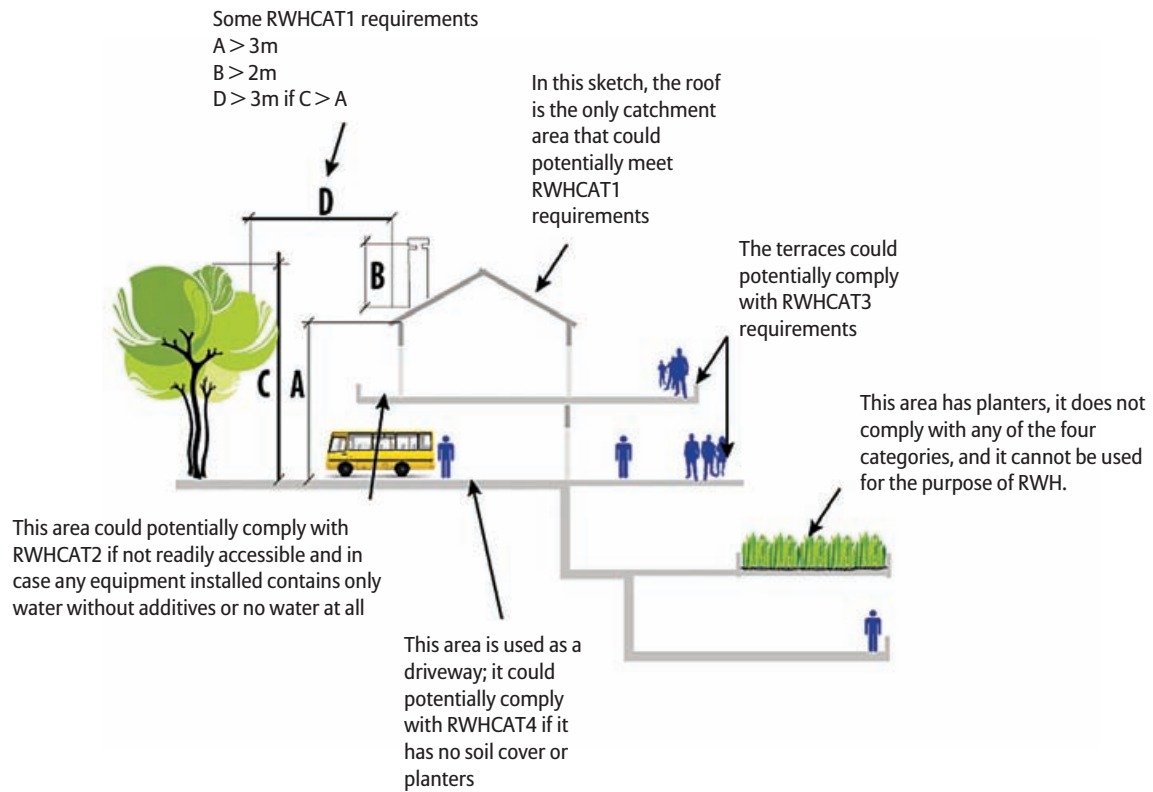
- Facility is above 500 m altitude if located in Mount Lebanon Mohafaza.
- Facility is at least 3 km away from any industrial plant that has smokestacks and 1,500 m away from a hospital that incinerates its medical waste.
- Facility is located in a village or an area that is sparsely populated.
- Lowest point of collection surface is at least 3 m above ground level.
- Collection area is not accessible for continuous human circulation, occupancy or use for solar water heating, photovoltaic, ventilation fans, AC condensing units or any sort of equipment and planters.
- Collection area has no exhaust outlets like kitchen exhaust, chimney outlet, boiler outlet, etc. that are at less than 2 m height from collection surface.

- There are no overhanging trees above Collection surface.
- Trees having a crown above the collection surface should be at least 3 meters away.
- Collection surface and drainage equipment are not made of asbestos, copper, lead or zinc.
- Collection surface is not used for plantations of any kind and has no soil layer.
- Rainwater storage tank should have food grade interior finish. For plastic or fiberglass tanks, food grade labeling should be specified by the tank manufacturer, for built on site concrete tanks, food grade is determined by the type of surface coating which should be specified food grade by the coating manufacturer.
- Rainwater harvesting system has a first flush tank in good working order.

2- **RWHCAT2** complies with the following minimum requirements:

- Collection area is not accessible for continuous human circulation, occupancy or use however equipment that is not filled with liquids (i.e: fans and photovoltaics) or filled only with water without additives (i.e: vacuum tubes solar collectors without anti-freeze) are tolerated.
- Collection surfaces and drainage equipment are not made of asbestos.





**Fig.6** Raw Water Harvesting Categorization

- Collection surface is not used for plantations of any kind and has no soil layer.
- Rainwater harvesting system has a first flush tank in good working order.

3- **RWHCAT3** complies with the following minimum requirements:

- Collection surface is not used as a driveway.
- Collection surface is not used for plantations of any kind and has no soil layer.
- Rainwater harvesting system has a first flush tank in good working order.

4- **RWHCAT4** complies with the following minimum requirements:

- Collection surface is not used for plantations of any kind and has no soil layer.

**RAINWATER HARVESTING CATEGORIZATION HELPS EXPAND AS MUCH AS POSSIBLE THE SAFE USE OF RAINWATER IN THE LEBANESE CONTEXT.**

## IMPORTANT

In this guideline rainwater that drains from planted areas cannot be used in rainwater harvesting applications.

## 4 RAINWATER USE CATEGORIZATION

Rainwater use categorization is a function of rainwater quality and treatment process, there are four USE CATEGORIES (USECAT) defining the scope of rainwater usage on the consumer premises; They range from the highest USECAT1 to the lowest

USECAT4. Of course the higher usage category could be used for the lower application, but obviously this implies a misallocation of resources.

**Table 8.** Water Use Categorization

USE CATEGORY	RECOMMENDED RAINWATER USE
USECAT1	Drinking, cooking (see note below)
USECAT2	Suitable for human contact except drinking and cooking (i.e: bathing, hand wash, housekeeping, laundry, sprinkler irrigation, car wash, hosing, surface cleaning)
USECAT3	Preferably no human contact, (i.e: Toilet flushing, laundry, drip irrigation)
USECAT4	Not suitable for human contact (i.e: Toilet flushing, sub-surface irrigation)

### IMPORTANT NOTE

USECAT1 is not applicable to hospitals, schools, hotels and other large facilities because RWHCAT1 which is a pre-requisite to USECAT1 is practically impossible for hospitals, hotels and most other public or office buildings while for schools and other large facilities, it may not be guaranteed that water quality is being constantly monitored as per USECAT1 requirements. Therefore USECAT1 is limited to residential applications.

DECIDING ON THE USE OF THE COLLECTED RAINWATER IS THE MOST IMPORTANT FACTOR IN PLANNING A RAINWATER HARVESTING SYSTEM

ALL OTHER CONSIDERATIONS INCLUDING RWH SYSTEM CONFIGURATION DEPEND ON IT

## 5 RAINWATER TREATMENT CATEGORIZATION

The categorization of the rainwater treatment is a function of RWHCAT and USECAT as explained in the next section.

Two Water Treatment Categories (WTCAT) are proposed in this guideline, namely WTCAT1 and WTCAT2.

WTCAT1 as (fig.7) below shows consists of a pre-treatment, a first stage treatment followed by a second stage treatment.

The pre-treatment stage consists of straining in the First flush tank then settling in the storage tank. The first stage treatment consists of Chlorination, media filtration then micro-filtration, the carbon filter may follow the first treatment stage but is not part of this stage. The product water is stored in a domestic water tank. The second stage consists of micro filtration, followed by a carbon filter if it was not installed downstream of the first stage then UV sterilization. The product water is stored in a potable water stainless steel storage tank. **This water treatment category implies also the monthly testing of the potable water at the potable water tap for bacteriological contamination.**

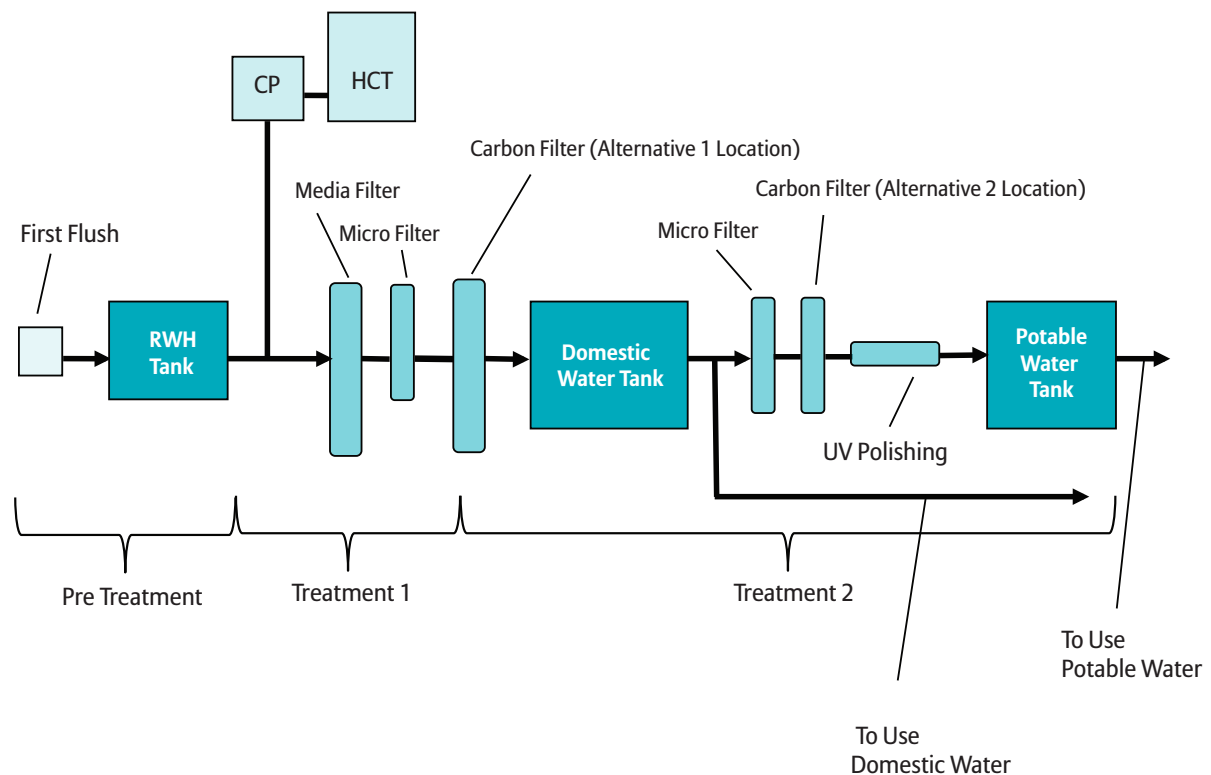


Fig.7 Water Treatment Category 1 Process Diagram - WTCAT1

WTCAT2 as (fig.8) below, consists of a pre-treatment and a first stage treatment. The pre-treatment stage consists of straining in the First flush tank then settling in the storage tank. The first stage treatment consists of Chlorination, media filtration then micro-filtration. The product water is stored in a domestic water tank. This guideline does not recommend a carbon filter for this application because for non-potable domestic water use, residual chlorine does no harm in the event some is still present in the water at the tap.

Kindly refer to Annex H to find out more about rainwater quality.

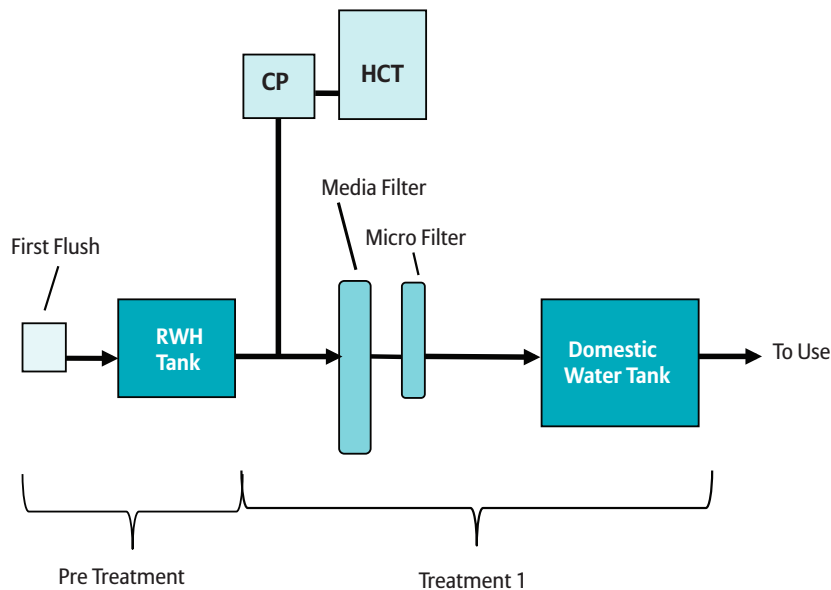


Fig.8 Water Treatment Category 2 Process Diagram - WTCAT2

WITHIN THE SCOPE OF THIS  
GUIDELINE, WATER TREATMENT IS  
NOT A LUXURY NOR IS IT AN  
OPTIONAL ITEM THAT COULD BE  
OVERLOOKED, IT IS A NECESSITY FOR  
THE SAFE USE OF RAINWATER

## 6 DIFFERENT OPTIONS FOR RAINWATER USE

The schematic below shows seven different schemes S1 to S7 that offer preferred combinations between RWH and RWT methods in view of a contemplated water use. The schemes represent minimum acceptable constructions to achieve water quality for a given use; it is always advisable to devise rainwater schemes that are more stringent than what is proposed below.

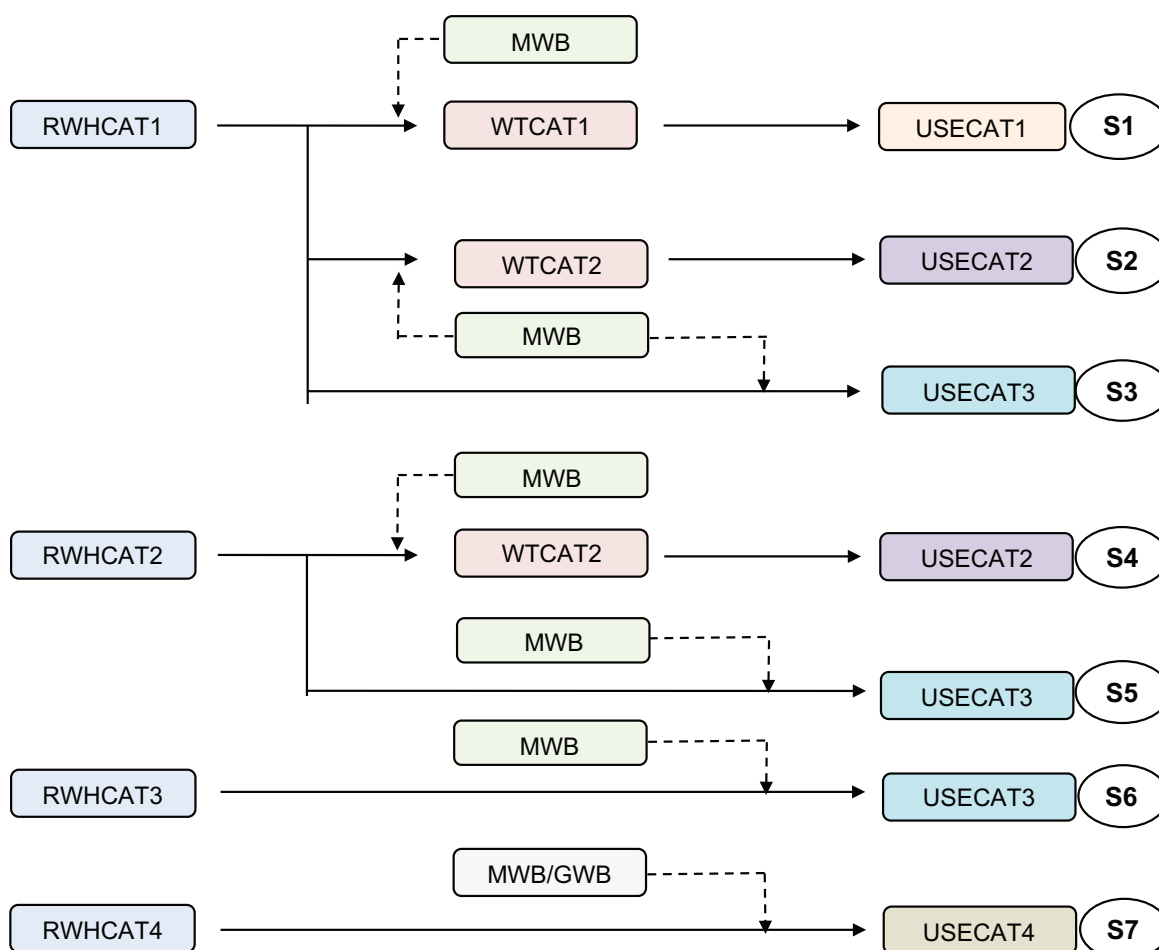


Fig.9 Recommended Rainwater Use Decision Tree

Even though not shown in the figure above, USECAT4 is applicable to RWHCAT1, 2 and 3 without any treatment, but it is not a recommended application from a resources allocation view point.

The reader will note that strategies S1 to S6 propose the optional use of Municipal Water Blending (MWB) while S7 shows the option of using Municipal water or Grey Water Blending (GWB), all with the aim of optimizing water resources use.

In S1, S2, S4 and S5 blending is done in a blending tank upstream of the treatment 1 stage while in S3 and S6 blending is done in a blending tank before water use. Dotted arrows in above combinations represent optional additions in the process that are not necessary to reach the sought after water quality using the proposed combination of RWH and RWT in a given scenario (See Chapter 3 for more details).

Blending has major advantages as follows:

1. It requires the storage of municipal water during the rainy season, (See next section)
2. It extends as much as possible the use of the rainwater stock
3. It is a natural and economic way to soften municipal or well water which is relatively hard in Lebanon. The TDS of municipal water is above 650 ppm in most regions of Lebanon and actually could be sensibly higher. Blending 50% rainwater 50% municipal water will cut the TDS practically by two and thus drastically decrease the hardness of the water without using a softener.

Actually in WTCAT1 and 2 softening is out of the question because rainwater even in the storage tank is still a relatively distilled water.

Detailed explanations on water treatment will be provided in section 3 below where system design will be tackled.

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THE READER WILL  
NOTE THAT  
STRATEGIES S1 TO  
S6 PROPOSE THE  
OPTIONAL USE OF  
MUNICIPAL WATER  
BLENDING (MWB)  
WHILE S7 SHOWS  
THE OPTION OF  
USING MUNICIPAL  
WATER OR GREY  
WATER BLENDING  
(GWB), ALL WITH THE  
AIM OF OPTIMIZING  
WATER RESOURCES  
USE.



## 7 THE MUNICIPALITY WATER STORAGE TANK

Large storage tanks for municipality water are a common occurrence for all types of buildings in Lebanon. One of the main reasons for such practice is the fact that utility water is not in continuous supply, actually in some regions of the country it is not uncommon for the municipality water to be cut off for several days in a row or even for weeks during the dry season especially in low rain years.

If blending is contemplated then municipality water storage tanks are a necessity. Because of water scarcity in Lebanon, such a tank has a similar function to the rainwater storage tank, but it harvests municipality water instead of rainwater. The idea is that from December to June municipality water is in good supply in most regions of the country, therefore the storage tank could be filled over few weeks while at the same time catering for the facility day to day use thus storing water for the dry season.

During the dry season, blending water could be drawn from the municipality water tank on a daily basis in conjunction

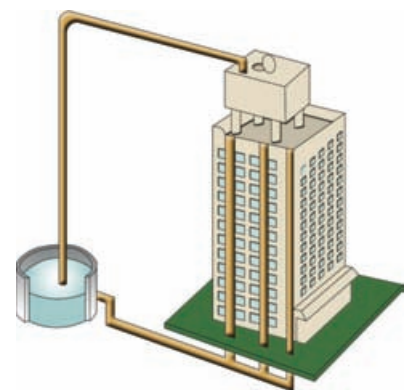
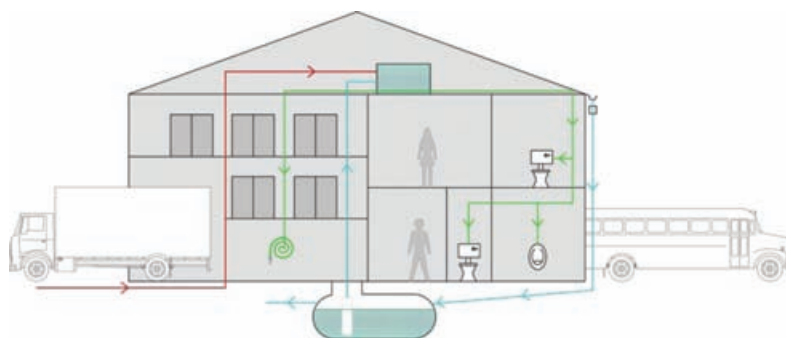
with the rainwater use. As a rule of thumb, the municipality tank volume should be between 30 – 50% of the rainwater storage tank volume depending on the severity of municipal water cuts during the dry season and the coverage period provided by the rainwater storage capacity. More on this will be covered in Chapter 3. Municipality water tanks offer strategic water storage especially during the period from August to October when municipality water or even truck water supply is at its lowest.

### IMPORTANT

One major advantage of blending equally rainwater with municipality water is the possibility to enjoy a supply of soft domestic water for an extended period without the use of softeners thus improving quality of life in the facility at minimum cost in case rainwater is in limited quantities but anyway is being contemplated as a source of water supply for the building.

Another strong point is that blending saves on the water storage volume in case of equal quantities blending because the municipality water tank is usually replenished with water though at a slow rate during the dry season.

The approach of this guideline is to completely disconnect between the municipality water supply and the rainwater system upstream of the blending tank. Thus it is not recommended to provide the rainwater storage tank with a municipality water supply line.



## 8 GREY WATER SYSTEM

Grey water is the effluent from lavatories, showers and bathtubs **only**. WC, Laundry machines, Dish washers, kitchen sink and other plumbing fixtures must not be part of the grey water network.

In a grey water system, these three types of fixtures are connected to a separate grey water drainage network that feeds into a grey water treatment scheme made up mainly of a settling/skimming tank, an aeration tank with chlorination, a 200 – 300 micron pressure filter and an effluent grey water tank which acts also as a blending tank.

In this guideline, Grey water systems are allowed only for blending with rainwater in USECAT4 applications. In this case rainwater from the RWH storage tank (RWHT) is conveyed to the effluent grey water tank (GWT) which acts also as a blending tank. The effluent grey water tank should be located in the grey water treatment plant. In no case it is allowed to pump the effluent grey water to a blending tank in the mechanical room where water treatment or water storage equipment is located. System should

be designed to prevent backflow of GWT into RWHT.

Effluent grey water blending is done in order to improve the quality of the grey water as far as hardness and alkalinity are concerned. This will greatly help to prevent clogging of the grey water supply pipes, valves and irrigation devices orifices.

### IMPORTANT

Treated Grey water should not be conveyed to any part of the facility other than the point of use. In the case of blending, rainwater from the RWH tank should be conveyed to the effluent grey water tank. It is not recommended to have a grey water blending tank in the mechanical room where water treatment equipment is located.

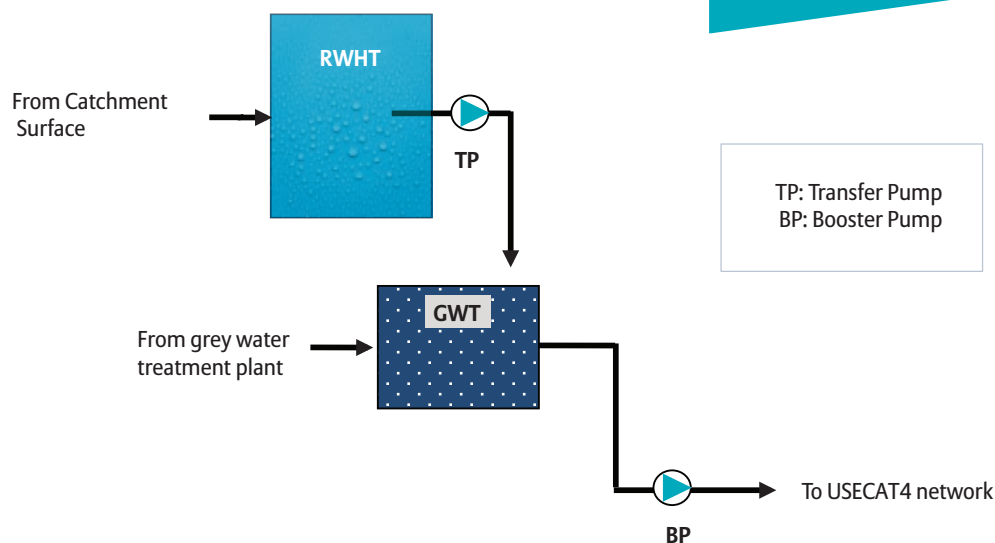


Fig.10 Grey water blending schematic

## 9 STORAGE TANKS HYGIENE

Rainwater or municipality water can be stored for several months without degradation in quality provided the storage tank does not allow sun light and the water is aerated. The issue of sun light is relatively simple to address, a concrete tank or plastic tank of opaque surfaces

will do the job. Aeration is another issue, it is most recommended to equip tanks higher than 50 m<sup>2</sup> capacity or tanks where water will be stored for more than 2 month, with a recirculation line. This system uses the storage tank pump which operates for a limited time daily to pump water and spray it back in the tank. Of course the tank should be vented with an outlet protected by an insect screen.

## 10 THE CASE OF TWO OR MORE CATCHMENT AREAS

If the facility has two or more potential catchment areas of different RWHCAT, it is preferable to have a storage tank for each area in order to avoid mixing higher quality rainwater with lower quality one. Indeed, if rainwater from a RWHCAT1 catchment surface is mixed with rainwater from a

RWHCAT3 catchment surface the mix will be considered a RWHCAT3, thus losing the advantages of the higher quality water.

However by judicious combinations, the two tanks could be used for common applications, for example a RWHCAT1 tank could feed in common with a RWHCAT2 tank the domestic plumbing system.

# 11 PLUMBING CIRCUIT CONFIGURATION

Normally, all plumbing fixtures are fed from one common circuit; however this does not need to be so if flexibility is required in order to optimize the use of water resources. Normally, all water that is used for domestic applications should be of potable quality because such water comes in contact with our skin and we may even ingest some un-voluntarily when under a shower for example.

Studies in several countries have shown that water used in WC and laundry machines do not need to be of potable quality with no effect on human health. This is so because to a certain extent, water used in laundry machines do not come in contact with our skin and this is more so with water for WC flushing.

Consequently, using separate plumbing circuits allows feeding laundry machines and WC or at least WC with lower quality water, (Table 9).

Four plumbing configurations are proposed, these offer the maximum flexibility in rainwater use depending on user requirements, site conditions, plumbing design and other related factors.

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DEDICATED PLUMBING NETWORKS FOR WC AND LAUNDRY ALLOW BETTER OPTIMIZATION IN THE USE OF WATER RESOURCES FROM A RAINWATER HARVESTING PERSPECTIVE

## PLUMBING

**PLUMBING1:** facility has one plumbing circuit that feeds all plumbing fixtures (Lavatories, bidet, shower, WC, laundry machine, kitchen sink, dishwasher, housekeeping hose bibs)

**PLUMBING2CL:** facility has two plumbing circuits; one feeds lavatories, bidet, shower, kitchen sink, dishwasher, housekeeping hose bibs and the other feeds the WC and laundry machine.

**PLUMBING2C:** facility has two plumbing circuits one feeds lavatories, bidet, shower, laundry machine, kitchen sink, dishwasher, housekeeping hose bibs and the other feeds the WC.

**PLUMBING2L:** facility has two plumbing circuits one feeds lavatories, bidet, shower, WC, kitchen sink, dishwasher, housekeeping hose bibs and the other feeds the laundry machine.

## NOTES

- USECAT1 is not considered because it applies only to potable water for cooking and drinking thus it has a separate plumbing network in all cases.
- PLUMBING 2C could be adopted also in case grey water is to be used for domestic purposes.
- The differentiation between PLUMBING 2C1 and 2C2 is necessary to indicate whether WC are fed with USECAT3 or USECAT4 water.

## IMPORTANT

- USECAT4 must be entered if irrigation network is underground; in this case the RWHCAT is irrelevant.

**Table 9.** Plumbing Network Configurations With Respect To USECAT Options

USECAT option	PLUMBING option	Remarks
USECAT2	PLUMBING1	All fixtures are fed from the same plumbing network, it does not make sense to have two plumbing circuits if one type of water quality is used for all fixtures.
USECAT3	PLUMBING2CL (best)	<i>PLUMBING2CL</i> is the preferred option, it allows the supply of WC and laundry with lower grade but most suitable water. It allows maximum use of rainwater for lower quality water.
	PLUMBING2C1 (good)	<i>PLUMBING 2C1</i> is the second best choice, it allows lesser flexibility in water use management but still allows considerable savings in water.
	PLUMBING2L (acceptable)	<i>PLUMBING 2L</i> is the least recommended because only limited quantities of lower quality rainwater could be used, but still it is a viable alternative.
USECAT4	PLUMBING2C2	PLUMBING 2C2 is compulsory if USECAT4 water is to be used for domestic purposes.





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# RAINWATER HARVESTING DESIGN GUIDE

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## 1 INTRODUCTION

## 2 APPLICABLE CODES, STANDARDS AND GUIDELINES

## 3 ADDITIONAL CONSIDERATIONS

## 4 DESIGN AND INSTALLATION GUIDELINES

- 4.1 Catchment Surface
  - 4.1.a Catchment Surface Area
  - 4.1.b Catchment Surface Materials

- 4.2 Drains, Gutters, Leaders and Downspouts
  - 4.2.a Sizing Drains, Gutters, Leaders & Downspouts
  - 4.2.b Drains, Gutters, Leaders & Downspouts Materials

- 4.3 First Flush Tank
  - 4.3.a First Flush Tank Sizing
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- 4.4 Storage Tanks
  - 4.4.a Sizing Storage tanks
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- 4.5 Water Treatment
  - 4.5.a Water Treatment Equipment Sizing
  - 4.5.b Water Treatment Equipment Materials

- 4.6 Pumps
  - 4.6.a Pump Sizing
  - 4.6.b Pump Material

## 5 MAINTENANCE

# 1 INTRODUCTION

This design guide deals only with rainwater harvesting systems applicable to domestic use, external housekeeping and landscaping requirements whether for residences, schools, hospitals, governmental institutions or any other facility where such uses are found.

Furthermore, the guide is intended for a large spectrum of people, from those technically minded who need additional information on the subject to those lay people that require a document that presents a step by step procedure how to devise, size, price and implement a rainwater harvesting system.

This section gives detailed procedures and calculations methods for the different steps towards implementing a RWHS while supporting data is found in the annexes.

It is worthwhile noting here that rainwater harvesting systems are available in many configurations therefore it is not practical for this guideline to cover all of these if the document is to be kept at a manageable size. Many factors influence component selection when designing or selecting the right rainwater system for a specific end use application. Available catchment areas, water conveyance, building architectural and structural features, aesthetics, buried utilities, soil types, slopes, site drainage, existing plumbing, electricity, routing of overflows, local regulations and neighbors are some of the many items that deserve attention when considering the implementation of RWH systems.

This guideline will give the necessary information to tackle effectively any configuration that is contemplated for a specific project.

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THIS SECTION GIVES DETAILED PROCEDURES AND CALCULATIONS METHODS FOR THE DIFFERENT STEPS TOWARDS IMPLEMENTING A RWHS WHILE SUPPORTING DATA IS FOUND IN THE ANNEXES.

## 2 APPLICABLE CODES, STANDARDS AND GUIDELINES

Local regulations related to rainwater harvesting systems are very sparse and deal with generalities, the only text relevant to consult is the potable water standard found in Annex C.

- Building law 646 dated 11/12/2004 (ref:15)
- Building law implementation decree 15873 (ref:16)
- Environment protection law 444 dated 29/7/2002 (ref:17)
- Potable water standard, decree 1039 dated 2/8/1999 (ref:18), (Annex C)

The following international codes and standards are of relevance for those who may be interested to consult them;

- International plumbing code 2006 (ref:8)
- NSF Protocol P151, Health Effects from Rainwater Catchment Systems Components (ref:23)

## 3 ADDITIONAL CONSIDERATIONS

These guidelines apply to buildings at the concept stage as well as for existing buildings. However the latter category may narrow the options offered in this document because the building structure already exists as well as the plumbing works. However, if the building is to be refurbished, then the guidelines could be used to maximum advantage.

Practically, this document contains all the information required to size a rainwater system without the need to have recourse to any other source or document unless the user embarks in very complex systems or wishes to consult other publications on this subject with the aim to expand their knowledge in this field.

## 4 DESIGN AND INSTALLATION GUIDELINES

This section addresses the sizing of the different components of the rainwater system, the selection of materials as well as installation tips. Reference will be made to annexes that contain the necessary data and information to properly perform the calculations for system sizing.

As previously indicated, a rainwater harvesting system consists of the following basic building blocks; a catchment surface, a conveying network and a storage component. These will be discussed first before tackling the two components that relate to improving the quality of the harvested rainwater namely the first flush tank and water treatment.

### 4.1 Catchment Surface

A main component of rainwater harvesting is the collection of rainwater from a catchment surface. The catchment surface could be a building roof, balconies, terraces, a fully closed top parking lot pergola or even a driveway. Water quality from different roof catchment surfaces is a function of the type of catchment surface, roof material, climatic conditions, and the surrounding environment. These factors will be tackled as we proceed below, however first let us find out how to compute the catchment area.

#### 4.1.a Catchment surface area

The example of an individual building will be considered, however the methodology explained could be used for any type of building or catchment surface.

The house in (fig.11) is a typical construction with a gabled roof (sloped roof) with :  
length A = 18.5 m and width B = 23 m which represent the building footprint on the ground.

**When dealing with sloped roofs, one should assume that the gables do not exist thus the building footprint dimensions are what matters.**

Hence for this particular construction the effective catchment area;

$$\text{Area (m}^2\text{)} = \text{Length (m)} \times \text{Width (m)} = 23 \times 18.5 = 425 \text{ m}^2$$

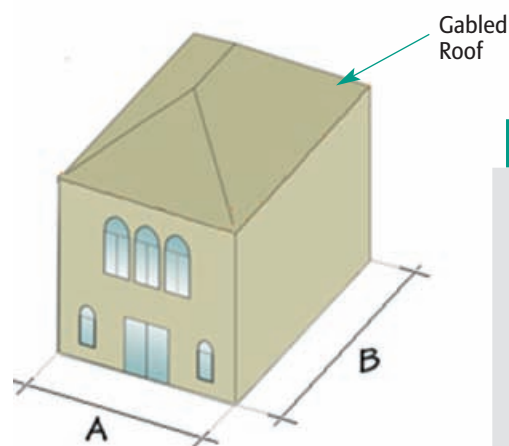


Fig. 11 Typical cube configuration (House 1)

### NOTE

For all practical purposes do not worry about decimals, always round to the lower number.

Let us consider a slightly more elaborate example, an L shaped half gabled roof building as shown in (fig.12). Again even with a flat topped gable the golden rule still applies

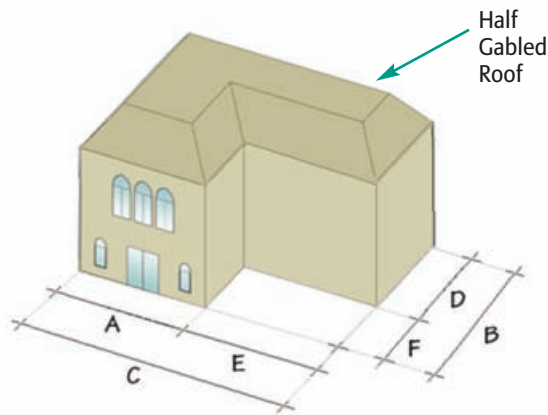


Fig. 12 Typical L shape Configuration (House 2)

Based on the above the footprint of the building in (fig.12) is;

$$\text{Building Footprint Area} = \text{Effective Catchment Area} = A \times F + D \times C = A \times B + D \times E$$

This formula was arrived at by dividing the L shaped building into two parts, the long and short branches of the L shape. This could be computed in two different ways depending on our choice of the long and short-branches.

Assuming  $A = 20$  m,  $B = 26$  m,  $C = 40$  m,  $D = 16$  m,  $E = 20$  m,  $F = 10$  m

$$\text{Catchment area} = 20 \times 10 + 16 \times 40 = 20 \times 26 + 16 \times 20 = 840 \text{ m}^2$$

## GOLDEN RULE

Regardless of the pitch, the shape, or the complexity of any roof surface, it is the overall footprint of the building that determines the effective catchment area.

Now that the catchment areas are known for both buildings, it will be simple to compute the potential rainwater that could be harvested over one rainy season. Remember from Chapter 1 that rainfall was expressed in mm height. Thus for example in Bhamdoun the average yearly rainfall is around 1300 mm or 1.3 meters (See annex A for precipitations corresponding to your location, if your exact location is not shown look for the nearest location available and use its precipitation data).

Imagine now that we remove the gables of houses 1 and 2 and put instead an open air reservoir, the water collected from the rain will reach a level of 1.3 meters for one average rainy season (assuming of course no evaporation). What is then the volume of water that could be collected?

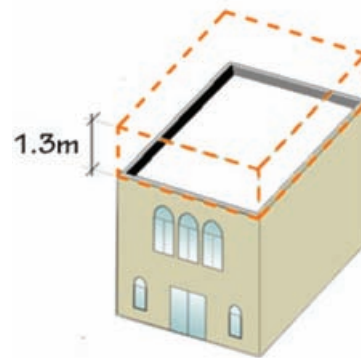


Fig. 13 Typical House 1 Virtual RWH Roof Reservoir

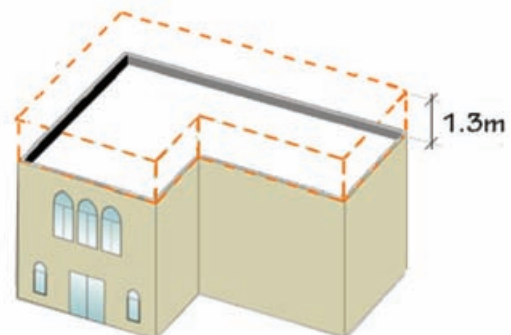


Fig. 14 Typical House 2 Virtual RWH Roof Reservoir



## THEORETICALLY, FOR EVERY SQUARE METER OF ROOF CATCHMENT AREA, 1 LITER OF RAINFALL CAN BE CAPTURED PER MILLIMETER OF RAINFALL.

$$\text{Volume (m}^3\text{)} = \text{Area (m}^2\text{)} \times \text{Height (m)}$$

Based on the above formula the potential water that could be collected is:

For house 1 volume of harvested (collected)

$$\text{rainwater} = 425 \times 1.3 = 552 \text{ m}^3$$

For house 2 volume of harvested (collected)

$$\text{rainwater} = 840 \times 1.3 = 1092 \text{ m}^3$$

However in practice and as seen in the previous section, the water is not collected directly by roof reservoirs, the run-off flows on the catchment area, it is then collected by the gutters or drains then routed to storage reservoirs at lower level. This process implies water losses due to the following;

- Nearly 50% of rainwater events in Lebanon yield less than 5 mm of water, in such cases, not much water reaches the storage reservoir because of evaporation on the roof, absorption by the roof material, leakage losses or loss in the first flush tank.
- In case of heavy rainfall, rain drops will cause splashing thus unavoidable losses.
- Also wind gusts may result in water carry over thus increasing the losses.
- Gutters, drain pipes and water storage reservoirs may be leaky.
- Clogged drainage pipes, drains, gutters and downspouts may cause overflows, thus loss of collectable water.

Based on the above, it is recommended to apply the de-rating factors as shown in Table 10.

**Table 10.** De-Rating Factor For RWH Catchment Surfaces

Type of roof	De-rating factor
Gabled catchment surfaces with concrete finish, terra cotta or glazed tiles.	0.75
Flat catchment areas with concrete finish, corrugated plastic sheet, tiled finish or water proofing membrane finish.	0.75
Flat roof with gravel layer finish	0.7

Source: Author estimates \*

Estimates \* : Based on several efficiency factors.

- DIN 1989-1: 2001-10.Rainwater Harvesting systems-Part 1 :Planning, Installation, Operation and maintenance.

2002 "Fachvereinigung Betriebs-und Regenwassernutzung e.v.fbr.Darmstadt"

- Watershed Management Group, 2006, Calculating Runoff for Water Harvesting.

## HINTS TO CONSIDER

- Roof materials should be preferably of smooth finish to facilitate surface flow and avoid microbial nesting.
- Pitched catchment surfaces are preferred to flat surfaces for RWH because of higher run off velocity thus providing better surface wash.
- Provide a slope of 1% for flat catchment surfaces towards drains to ensure good run off and avoid water settling, which is a source of pollution.
- Roofs with lead components (for example, flashing or solder), copper, zinc or asbestos should not be used in any application with a potential for human ingestion (i.e. drinking water, pool filling, vegetable gardens).
- Green roofs are not suitable for rainwater harvesting.
- Do not mix whenever possible rainwater of different qualities in a common storage tank.

Thus the **effective rainwater harvested** for both examples are respectively:

Volume of effective harvested rainwater for House 1 =  $425 \times 1.3 \times 0.75 = 414 \text{ m}^3$

Volume of effective harvested rainwater for House 2 =  $840 \times 1.3 \times 0.75 = 819 \text{ m}^3$

A de-rating factor of 0.75 was used because both houses have gabled roofs with terra-cota tile finish.

### **4.1.b Catchment Surface Materials**

The designer of a RWHS has no control over the rainwater quality falling from the sky but he/she can influence the amount of contaminants transferred from the roofing materials to the flowing water once it runs off the catchment surface. The selection of roofing material is a design choice and can have a significant effect on the quality of harvested rainwater especially in what relates to toxicity. Chemical reactions on catchment surfaces are often rapid because of the acidity of rainfall and sometimes because of the relatively high temperatures on many rooftops especially when it rains after a sunny interlude. These reactions make the choice of roofing material an important consideration in designing a rainwater harvesting system, particularly for potable uses.

There are four types of materials that should not be used for catchment surfaces used to convey rainwater destined for potable use namely; asbestos, copper, lead and zinc. For other applications, these restrictions could be relaxed except for asbestos, thus only asbestos is not recommended in all cases.

## 4.2 Drains, Gutters, Leaders and Downspouts

Drains and Gutters collect the flow of rainwater from catchment surfaces to be routed by Leaders and Downspouts to the storage reservoir. It is now high time to clarify what the four terms (Drains, Gutters, Leaders and Downspouts) are about.

Drains collect run off water, they are used mainly for flat surfaces like a flat roof, a terrace or a driveway. Drains could have flat strainers (fig.15), domed strainers (fig.16) or tower strainers (fig.17).

A strainer is the slotted surface where water enters the drain, it is slotted to prevent relatively big objects to enter the drain and clog it. Flat strainer drains are used for locations where there is little possibility to have debris of relatively large size that could block the drain strainer.

Flat strainer



Fig. 15 Floor Drain

Domed strainer



Fig. 16 Dome Type Roof Drain

Thus flat drains are used usually indoors and also on balconies and terraces which sometimes may be the source of great annoyance due to flooding if the strainer is clogged by leaves.

Domed strainers are used on roofs and other surfaces where there is high probability of encountering leaves, papers and other large objects that may obstruct the drain inlet. Tower drains are used mainly for tiled roofs where water could be drained from the surface as well as below the tiles.

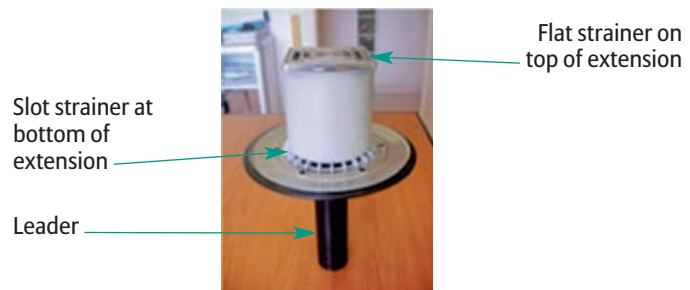


Fig. 17 Tower Type Roof Drain

Drains are connected to leaders or pipes that convey the water to the storage tank. Thus to the term **Drain**, we associate the term **Leader** to mean the drainage pipe.

Gutters are more commonly associated with gabled roofs, they are more adapted than Drains to carry out this function. While Drains are point collection devices Gutters are linear, they run along the perimeter of the surface to be drained at its lowest level (fig.18).

Gutters usually have half circular, square or trapezoidal shapes. Downspouts are connected to gutters to conduct the water to the storage tank (fig.18).

Gutters do not usually have strainers; they are open channels that could collect all sorts of debris that may clog the entrance to the Downspout.



Fig. 18 Typical Gutter & Downspout Configuration for a Gabled Roof

#### 4.2.a Sizing Drains, Gutters, Leaders and Downspouts

Sizing of Drains, Gutters, Leaders and Downspouts is fairly easy but should be properly done to maximize the quantity of harvested rainwater and avoid spill overs, overflows and other malfunctioning. Let us consider the two houses of the previous section. Suppose the houses have flat roofs, therefore making drains a more suitable proposition.

Drains are specified by their connection size, hence a 4 inch (110 mm) drain connects to a 4 inch pipe or Leader. As a rule of thumb, every 200 m<sup>2</sup> of projected roof area requires a 110 mm drain. Actually the present guidelines do not recommend roof drains of smaller size even for roof areas less than 200 m<sup>2</sup>. Thus if a roof has a projected area of 300 m<sup>2</sup> then allocate one 110 mm drain for each 150 m<sup>2</sup>. The roof slopes should be worked out accordingly.

Thus for house 1 based on an area of 425 m<sup>2</sup>, 2x110 mm drains will be most appropriate.

House 2 has a catchment area of 819 m<sup>2</sup>, thus 4x110 mm drains should be provided.

We have now the size of the drains and vertical leaders. What about if the Leaders should run horizontally to reach the rainwater harvesting storage tank?

(Table 11) returns the size of horizontal leaders for a given slope and catchment area based on a maximum rainfall rate of 50 mm/hour. The slope is the amount of inclination of a horizontally running pipe expressed as vertical drop per meter of horizontal run, thus 1% slope is a drop of 1 cm per 100 cm of pipe run.

In the case of house 1, if the 110 mm vertical leader is to be routed horizontally, it is necessary to have a slope of 2% if it has to serve the area of 425 m<sup>2</sup>. In (Table 11) the maximum catchment surface area served by a 110 mm horizontal leader with 2% slope is 492 m<sup>2</sup>. If it is impossible to run a 2% slope because of obstructions and only a 1% slope is possible then the leader size should be increased to 125 mm.

**Table 11.** Sizing Of Horizontal Leaders - (Ref:8)

DIAMETER OF HORIZONTAL PIPING (inches)/mm	HORIZONTALLY PROJECTED ROOF AREA (m <sup>2</sup> ) FOR A RAINFALL RATE OF 50 mm/hour			
	1 % SLOPE	2 % SLOPE	3 % SLOPE	4 % SLOPE
(4)/110	349	492	595	699
(5)/125	621	877	1,059	1,241
(6)/150	994	1,403	1,695	1,988
(8)/200	2,137	3,028	3,651	4,273

Source: IPC 2006

Sizing Gutters follows the same methodology but involves additional considerations. (Table 12) is used to size semi-circular gutters but any gutter shape could be accommodated by using the equivalent circular size which is the circle that could fit inside the contemplated shape.

Thus if a rectangular gutter can accommodate a 110 mm circle, then it has a 110 mm equivalent circular size. In other words it is equivalent to a 110 mm semi-circular gutter.

Gutters are sized by sections because each section serves one gable. **It is not recommended to have flow direction change in a gutter.** Thus if Gutters drain the gabled roof of house 1, one straight run will drain each side of the gable, however the downspouts at the extremities of two adjacent gutters could be joined into one downspout (fig.20).

**Table 12.** Sizing Of Gutters - (Ref:8)

DIAMETER OF GUTTERS (inches)/mm	HORIZONTALLY PROJECTED ROOF AREA (m <sup>2</sup> ) FOR A RAINFALL RATE OF 50 mm/hour				
	0.50% SLOPE	1% SLOPE	2% SLOPE	3% SLOPE	4% SLOPE
(3)/90	32	45	63	76	89
(4)/110	67	95	134	162	190
(5)/125	116	163	232	281	329
(6)/150	178	253	357	436	515
(7)/180	256	362	513	619	725
(8)/200	370	520	739	890	1040
(10)/250	669	948	1338	1598	1858

Source: IPC 2006

Moreover even though there may be four gables, but in no case should the allocated catchment area for any one section of gutter serving one gable be less than half the projected area of the roof.

As a practical example, consider again house 1, each gable face will be drained by one gutter, the two adjacent gutters of faces 1 and 2 will be sloped towards each other and their downspouts will be connected. The same happens for faces 3 and 4.

## IMPORTANT TO REMEMBER

The de-rating factor used to compute the potential rainwater quantity that could be harvested does not apply when sizing drains, leaders, gutters and downspouts for rainwater harvesting.

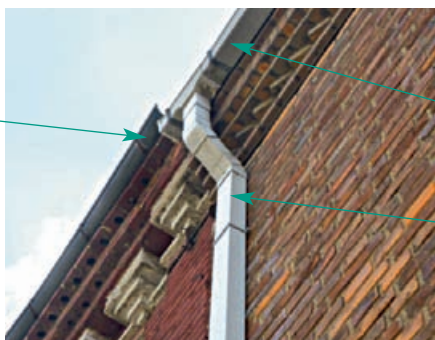
## HINTS TO CONSIDER

- Straight sections of gutters served by two downspouts should have opposite slopes starting at their middle.
- The outside face of the gutter should be lower than the inside face to encourage water flow away from the building wall.
- Half-round or trapezoidal gutters are preferred for rainwater harvesting because of more efficient drainage. Square or rectangular sections should be avoided; they are more difficult to clean.
- It is preferable to increase the slope of the gutter by 0.5% on the last 1/3 length of the gutter before the downspout.
- Downspouts shall serve no more than 20 m of gutter length.

Any gutter of house 1 will be sized to drain a catchment area  $425/2 \text{ m}^2$  or  $212 \text{ m}^2$ . Assuming a 1% slope is selected, (Table 12) gives a diameter of 150 mm.

Downspouts sizing is rather straightforward, these should have the same circular size as the gutters they drain. It is important to note that downspouts may have rectangular shapes (Fig.19). In such cases the rectangular downspout will be considered equivalent to a circular pipe having a diameter equal to the smallest side of the rectangular downspout. For the rectangular downspout shown in the below photo it is 110 mm, thus the downspout was considered equivalent to a 4 inch pipe.

Circular gutter  
draining into  
the  
rectangular  
gutter below



Rectangular  
gutter

Rectangular  
downspout

**Fig. 19** View of a Rectangular Downspout

It is important to note that downspouts cannot serve more than 20 meters of gutters length, this is so because of flow conditions and the probability of clogging a downspout because of debris.

Going back to the example of house 1, one side of the building has a length higher than 20 meters, thus it is important to have two downspouts per section of gutter serving that side.

Each downspout is sized based on the area served by the gutter, thus for the first section serving an area of  $215 \text{ m}^2$ , it will have two downspouts of 110 mm each. If a rectangular downspout is to be used, then its smaller side should be no less than 110 mm.

Moreover, It is possible to join two stretches of gutters into a single downspout as long as the gutters have their individual downspouts outlets (Fig.20) and the downspout is sized accordingly taking into consideration the total area of gables being drained.

Gutter and downspout made of PVC, this type of material is not recommended for locations with high solar exposure



**Fig. 20** Detail of a common Downspout



#### 4.2.b Drains, Gutters, Leaders and Downspouts materials

Drains for external surfaces come mostly in three constructions for the body and the strainer, namely PVC, PE or cast Iron. It is recommended to use cast iron drains with cast iron strainers for exposed surfaces to the sun.

Gutters, Leaders and downspouts could be PVC, galvanized sheet metal, epoxy coated sheet metal, anodized sheet metal, copper, seamless aluminum or even stainless steel. It is recommended not to use PVC for exposed components as it structurally weakens if continuously exposed to the sun's rays. Copper may

oxidize thus it should be ruled out if the intent is to use rainwater for domestic purposes. The choice in order of decreasing preference is stainless steel, aluminum, epoxy coated sheet metal and last galvanized sheet.

Gutters with built in wire mesh as cover is an excellent idea as it will greatly reduce the probability of leaves and other solid objects entering the waterways thus clogging the gutter.

Regardless of material, other necessary components in addition to the horizontal gutters are the drop outlet, which routes water from the gutters downward through the downspout pipe. Additional components include support brackets and straps which could be of similar material as for gutters and downspouts. Use fasteners that do not rust to avoid rust smearing on the fascia and walls.

### 4.3 First Flush Tank

This device shown in figures 22-23 below serves to divert to waste the first rains of each rainfall event which are usually laden with contaminants carried over from the catchment area like dropping, dust, leaves, blooms, twigs, insect bodies, pesticides and other airborne residues.

The tank is sized to flush the equivalent of around 1.5 mm height of rainfall. It will then automatically rout the relatively clean rainwater to the storage tank. This device has two main advantages;

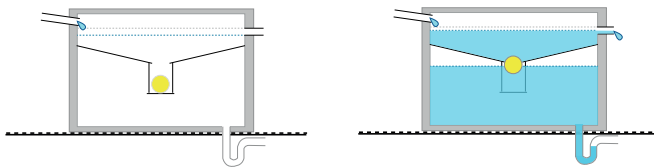
## HINTS TO CONSIDER

- For domestic rainwater use including potable water applications (USECAT1 & 2), lead cannot be used as gutter solder. Rainwater acidity could dissolve lead and thus induce lead contamination. Certified solder material should be selected.
- Where possible, locate the Leader or downspout near the location of the rainwater storage tank.

- It saves the trouble of having to divert the first rains manually, a practice that wastes rainwater. This is especially so because rainfall events in Lebanon are sometimes separated by a relatively lengthy dry period that may extend for weeks, the catchment surface flushing needs to be performed at the onset of nearly each important rainfall event.
- It improves rainwater quality that enters the storage tank, thus enabling a greater flexibility in its use while saving on water treatment.

The method of operation of the first flush tank is extremely simple and practically trouble free if the tank is cleaned at the end of the rainy season. The inlet water is intercepted by a strainer that retains all objects bigger than 2 mm. The water then runs off the sloped plate below the strainer and into the waste chamber through the 90 mm center hole.

The water exits the bottom of the tank at a very low flow rate (thru the Ø32 mm drain pipe or by percolation) thus resulting in an increase in water level which raises the 100 mm plastic ball till it closes completely the center hole thus diverting the water to the tank outlet and into the storage tank (fig.21).



**Fig. 21** Detail of First Flush Tank Operation

The first flush tank could be installed below ground or above ground depending on the system configuration. (fig.22A/22B)

For optimum water use, the waste water from the first flush tank could be stored in a separate tank that could be used for irrigation purposes. This tank needs to be cleaned yearly of deposits.

For Construction details see Annex F.

#### 4.3.a First flush tank sizing

The sizing is fairly straight-forward, the only dimension required is X which is for one side because the tank has a square configuration. X is given as a function of catchment area as follows;

$X = 0.005 * S$  where S is the projected surface of the catchment area.

Thus for a 200 m<sup>2</sup> catchment area, (S=200),  $X = 0.005 * 200 = 1$  m

**FOR OPTIMUM WATER USE, THE WASTE WATER FROM THE FIRST FLUSH TANK COULD BE STORED IN A SEPARATE TANK THAT COULD BE USED FOR IRRIGATION PURPOSES.**

It is recommended not to exceed a catchment area of 200 m<sup>2</sup> per tank. Thus for a catchment area of 350 m<sup>2</sup> of same RHWCAT, it is recommended to have two tanks operating in parallel. each sized for half the projected area.

#### 4.3.b First flush tank material

For underground installations, a masonry or reinforced concrete body is recommended while the trim (Tank cover, strainer, run off plate, ball holding plate, threaded rods) should be preferably galvanized steel or epoxy coated steel. The ball should be of good quality plastic or alternatively brass.

For aboveground installations the body may also be made of galvanized steel especially if the first flush tank is installed near ceiling level in mechanical room.

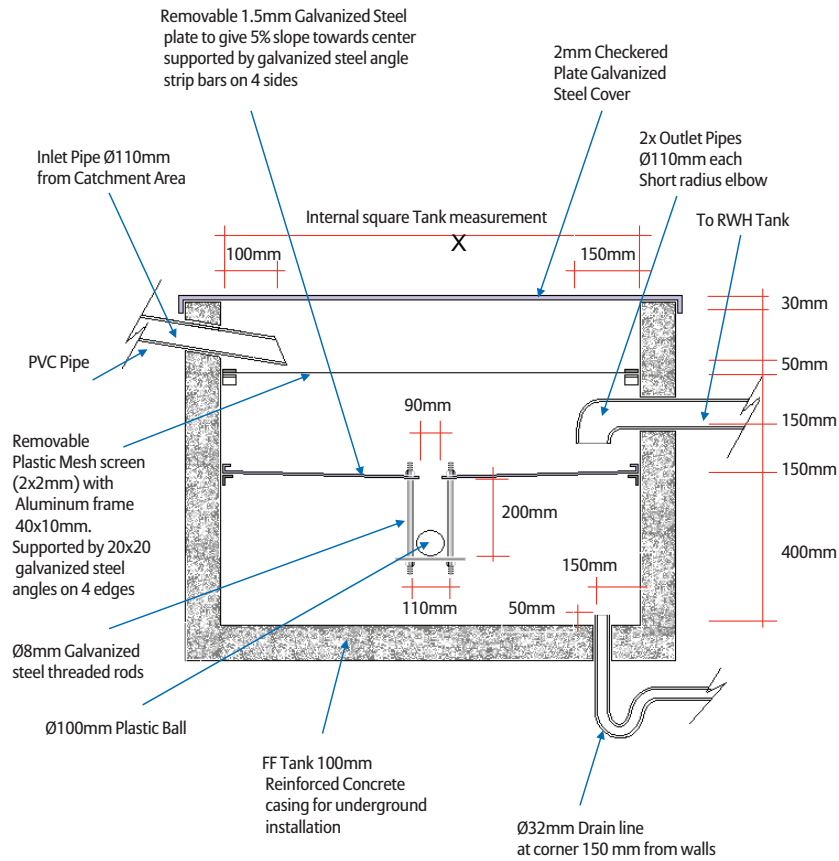


Fig. 22A Detail of Underground First Flush Tank

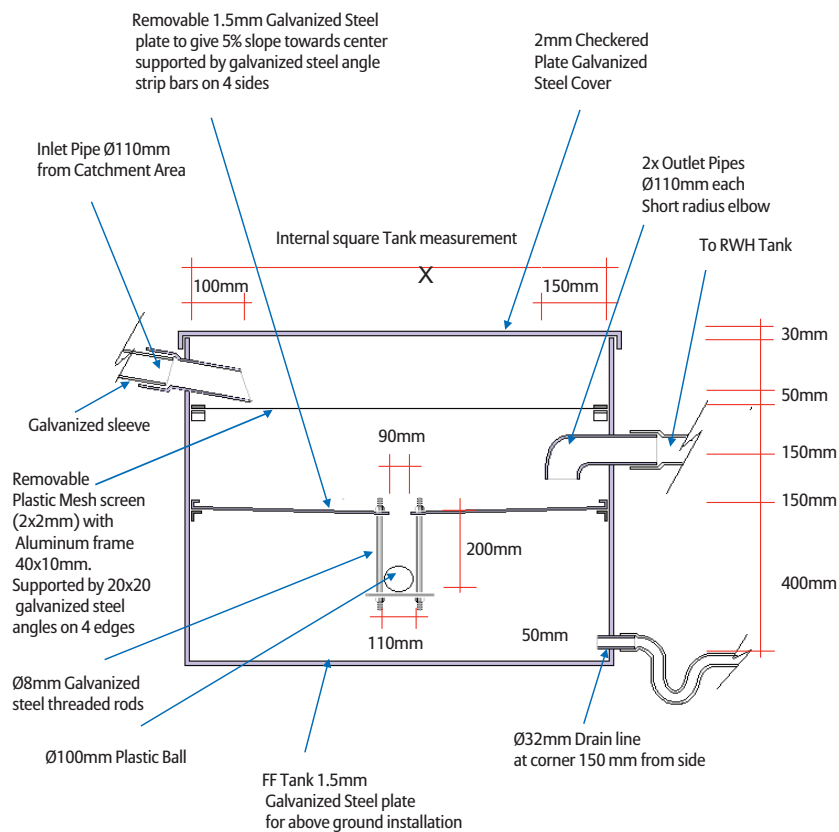


Fig. 22B Detail of Above Ground First Flush Tank

## 4.4 Storage Tanks

The storage tank or cistern generally is the most critical design component of a rainwater harvesting system. In most cases it is permanent and its placement should be carefully thought out.

Tanks can be placed either above or below ground. For both options, water should be able to gravity feed to the tank. Locating the tank near the building and the water use reduces the amount of pipe and site work necessary as well as pumping demands. Though no hard and fast rules govern the decision of aboveground or belowground tanks, in general, once the storage volume exceeds 10 m<sup>3</sup> belowground storage is often the most viable option. Beyond this, tank location is dependent on aesthetics, climate and soil conditions. However, placing tanks underground adds to the installation costs and may be limited in areas where soil is especially rocky or areas with a high water table. When tanks are installed below ground, water is maintained at a cool temperature and light is blocked, which reduces the chances of bacterial growth.

Existing structures should be considered when installing a RWH system. Water is normally conveyed from the catchment area to storage tanks by gravity. Think carefully about the location of drains, gutters and downspouts to maximize the use of existing installations and to collect water from a roof area that will support water demand. For above ground installations, the tank foundation must be flat, and capable of supporting the weight of maximum storage. Locate tanks in areas that are not subject to erosion, flooding or other factors that might undermine the integrity of the foundation. Consider how electricity can be delivered to the pump of the RWH system, and how rainwater supply lines can be safely added to existing plumbing.

More than one storage tank may be considered if catchment areas and site conditions dictate that decision or if segregation of collected rainwater by quality is planned. It is a waste to mix a RWHCAT1 source with a RWHCAT3. For example the tank could have different compartments to accommodate each rainwater category.

### 4.4.a Sizing storage tanks

While rainwater harvesting has a number of environmental benefits, it must also be economically viable to enter the mainstream of building practices. Because the tank is often the most expensive component of a rainwater harvesting system, decision-making on tank size can have a strong impact on the economic feasibility of rainwater harvesting.

The size of storage tanks is dictated by several variables including:

- Rainfall in the area considered
- Projected daily water demand
- Length of dry season
- Catchment surface area
- Aesthetics, personal preference
- Budget.

No doubt the Length of the dry period is one of the most important governing factors in the design of a RWHS in Lebanon which experiences a dry season that extends over some 7–8 month. This is not the case for countries further west like Europe where rain hardly stops around the year. Consequently, rainwater harvesting tanks in Lebanon should be of relatively large size if one plans to use rainwater as a source of water supply.

The sizing process starts by determining what use will be made of the rainwater and the quantity required. This guideline proposes four use categories defined in Chapter 2. The decision on the use category should be made based on the availability of corresponding catchment areas. For example it does not make

economic sense to decide on a USECAT1 or even USECAT2 if only a RWHCAT3 or RWHCAT4 area is available.

Once this decision is made, the required quantity of water could be determined using the demand table in Annex D and the time coverage. The table gives water

demand data based on demand type detailed down to the type of fixture used, use category, use type (Domestic, irrigation, car wash), types of plants for irrigation, irrigation type (sprinkler, drip, hose, underground), use mode (water saving or normal) and application (residential, school, hospital, etc.), based on these choices one can read the required water demand. Column 8 (plumbing) is not required for determining water demand but rather it shows the type of plumbing installation necessary for certain applications.



**Fig. 23** Storage Tanks

**As an example**, consider that house 1 is occupied by a family of 6 persons and has a garden having 25 m<sup>2</sup> of green lawn (gazon) as well as 250 m<sup>2</sup> planted with 60 shrubbery and Trees. The owner decides to have USECAT1 and USECAT2 for domestic purposes (including car wash, external surface cleaning) and for the lawn (sprinklers) and USECAT3 for trees and shrubbery (drip). The rainwater supply should be enough to cover 5 month of consumption ( $T_c = 5$  month) which is the period when municipal water supply is somewhat reduced and owners do not want to take the risk of

relying on private tankers. The owners did not install a swimming pool, not because they lack the means but because they believe it is a luxury the water supply condition of the country cannot afford. The owner is very conscious about water saving, therefore all plumbing fixtures are water saving type as well as the dishwasher and laundry machine.

RWHCAT1 catchment surface will be used to supply USECAT1, USECAT2 and USECAT3 because the roof of the house complies with all requirements for RWHCAT1. No other surface is available for harvesting other than the driveway and owner does not wish to use it as catchment area.

RWHCAT1 supply is calculated as per Tables 13/14/15 below using data from Annex D.

**Table 13.** House 1 Domestic Water Consumption

RWHCAT1 supply	Demand (l/p/d)	Persons	Period (days)	Total m <sup>3</sup>
USECAT1 (Drinking, Cooking)	3	6	150	2.7
USECAT2 (Domestic saving mode)	85	6	150	76

**Table 14.** House 1 Irrigation Water Consumption Sprinklers

RWHCAT1 supply	Demand (l/m <sup>2</sup> /d)	Area m <sup>2</sup>	Period (days)	Total m <sup>3</sup>
USECAT2 (Sprinkler for green lawn)	7	25	150	26

**Table 15.** House 1 Irrigation Water Consumption Shrubberies/Trees

RWHCAT1 supply	Demand (l/shr/d)	Shrubs pcs	Period (days)	Total m <sup>3</sup>
USECAT3 (Shrubbery and trees)	1.5	60	150	13.5

The total water demand of the house is 116 m<sup>3</sup> which is the rainwater storage quantity required assuming municipality water is not used during the coverage period. The rainwater quantity required is well within the potential 414 m<sup>3</sup> that could be collected on an average rainy year. Actually rainwater could cover house 1 needs even in the dry years when rainfall could reach 40% of the yearly average.

It is worthwhile noting that the 25 m<sup>2</sup> of green lawn consume twice as much as the 250 m<sup>2</sup> of shrubbery and 1/3 of the overall domestic consumption. Green lawns could be a nice thing but they are practically an environmental disaster from a water consumption viewpoint in the Lebanese context.

Thus for house 1 a 150 m<sup>3</sup> nominal volume underground RWH storage tank is required, nominal volume being the physical volume of the tank and not the effective water holding capacity. As a rule of thumb physical volume should be 20% larger than effective holding capacity, mainly to allow for the sedimentation zone at the bottom (approximately 10% of tank volume) and the overflow clearance at the top section of the tank.

Because the roof catchment capacity is larger than reservoir capacity, the reservoir will overflow once filled up and the surplus water will be directed to the storm drainage network. Or alternatively, the owner could decide to extend the period of use to seven month and build a 200 m<sup>3</sup> storage tank.

In all cases, the tank should overflow at least once a year so that floating debris are drained away from the water surface.

There is a point of diminishing returns beyond which increasing the tank size provides only a marginal benefit, in the case of House 1, the optimum size is actually 200 m<sup>3</sup>.

### Use of blending with municipality water

If blending is contemplated thus extending the period of use of soft water in case rainwater is in limited supply or the RWH tank needs to be downsized, municipality water is equally blended with rainwater thus cutting by half the RWH tank capacity. Sizing of the municipality water storage tank will be done as follows.

Check the Municipality Water Availability (MWA) in your area according to the classification shown in Table 16 below;



**Table 16.** Classification Of Municipality Water Availability

MWA	DESCRIPTION
HIGH	Municipality water is available: <ul style="list-style-type: none"> <li>• All year round at least once every two days for at least 5 hours</li> </ul>
MEDIUM	Municipality water is available: <ul style="list-style-type: none"> <li>• November – May: at least once every three days for at least 5 hours</li> <li>• June – October: at least once every four days for at least 5 hours</li> </ul>
LOW	Municipality water is available: <ul style="list-style-type: none"> <li>• November – May: at least once every three days for at least 5 hours</li> <li>• June – August: at least once every four days for at least 5 hours</li> <li>• September – October: once every week for at least 5 hours</li> </ul>
VERY LOW	Municipality water is available: <ul style="list-style-type: none"> <li>• November – May: at least once every three days for at least 5 hours</li> <li>• June – August: at least once every four days for at least 5 hours</li> <li>• September – October: Municipality water is Occasional or completely cut off</li> </ul>
NONE	Facility is not connected to the municipality network or municipality water is occasional

Based on the MWA classification obtained from Table 16 above, on the overall daily water demand of the facility ( $D_w$ ) and on the coverage period required ( $T_c$ ), the municipality water storage tank effective volume ( $V_m$ ) could be computed according to below;

**1. Case 1: If MWA = High,**

$V_m = 20 \text{ m}^3$  if the facility water demand for 20 days is less than  $20 \text{ m}^3$ ,  
Otherwise,  
 $V_m = 20 * D_w$

**2. Case 2: If MWA = Medium**

$V_m = 30 * D_w$  if  $T_c > 4$  month,  
Otherwise,  
 $V_m = 20 * D_w$

**3. Case 3: If MWA = Low**

$V_m = 50 * D_w$  if  $T_c > 6$  month,  
Otherwise,  
 $V_m = 30 * D_w$

**4. Case 4: If MWA = Very Low**

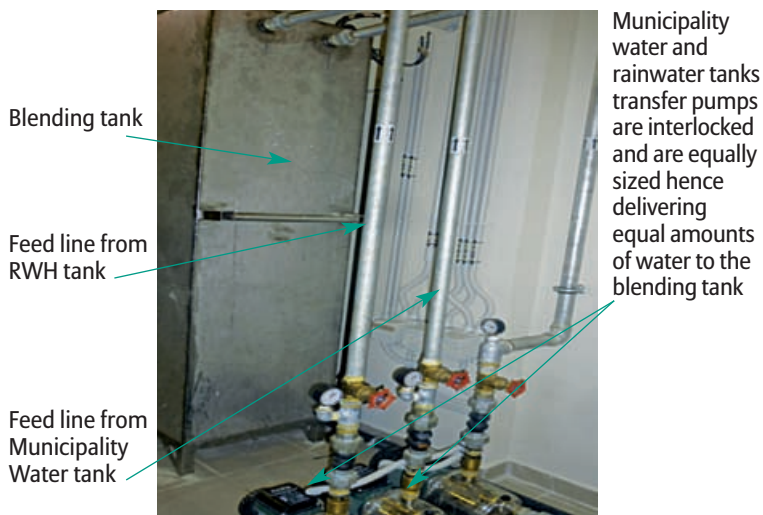
$V_m = 70 * D_w$  if  $T_c > 6$  month,  
Otherwise,  
 $V_m = 50 * D_w$

The volume of the tank is obtained by multiplying the effective volume computed above by 1.2

Going back to house 1, suppose the occupants are interested in blending for cost reduction considerations given that municipality water is fairly available. The occupants consider that the MWA could be rated as low however to be on the safe side they opt for a very low MWA.

Based on a  $T_c = 5$  month,  $D_w = 116/(5 \cdot 30) = 0.77 \text{ m}^3/\text{day}$   
This is case 4 with  $T_c < 6$  month, accordingly  $V_m = 50 \cdot 0.77 \sim 40 \text{ m}^3$  for rounding purposes.  
Thus the savings in storage volume is  $= 1.2 \cdot (116/2 - 40) = 22 \text{ m}^3$

Note: the factor 1.2 is used to compute actual tank volume given the effective water volume to be used.



**Fig. 24** Typical blending tank configuration

### Use of grey water

Suppose the occupants of a facility wish to use grey water blending in a USECAT4 application, the purpose being to enhance the quality of the effluent grey water from the grey water treatment plant. The first step should be the evaluation

of USECAT4 demand which could consist only of irrigation water or water for WCs or alternatively a combination of irrigation water and water for WCs.

The Table in Annex D can be used to determine USECAT4 demand of the facility based on the choices made by the occupants.

The Effluent grey water and rainwater quantity required for blending should be computed based on an equal percentage blending.

Back to house 1, suppose the occupants would like to use the grey water for irrigation and WC. Typically, grey water from lavatories and showers amount between 35% to 40% of domestic water consumption, while WC consumption is equivalent to some 30% of domestic water consumption. From Tables 13, 14 and 15 above, irrigation amounts to 52% of domestic water consumption, consequently grey water even if blended cannot meet the irrigation and WC consumption requirements.

Consequently, blending should be done with a higher rainwater contribution. The reduction in rainwater requirements is around  $76 \cdot 0.35 = 27 \text{ m}^3$ . (See table 12 above)

GWT size should not be higher than the daily USECAT4 consumption, in our case it should be sized as  $(26 + 13.5 + 76 \cdot 0.4)/150 \sim 0.5 \text{ m}^3$  (as nominal volume). Whatever inflow exceeds the holding capacity of the GWT will overflow to the sewer system of the facility.

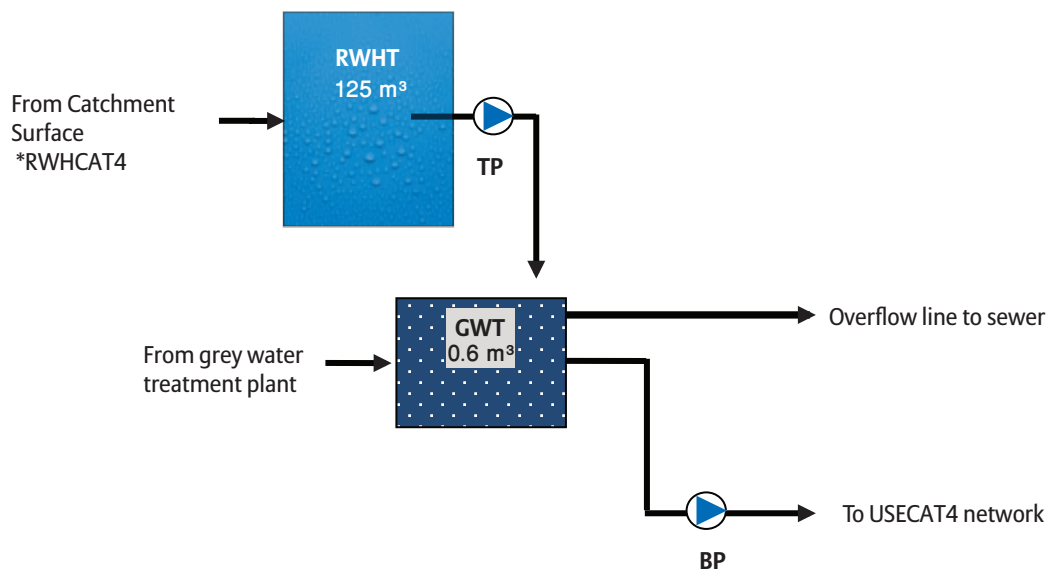


Fig.25 Grey water blending schematic example

The transfer pump TP should be timed to deliver 15% of GWT capacity every hour between 8 am and 10 pm, hence in our case if the pump flow is rated 1.5 m<sup>3</sup>/hr, then pump should operate for  $0.15 \times 0.6 / 1.5 = 0.06$  hour or 3.6 minutes/hour. However timing could be modulated according to the facility schedule and occupancy the objective being to approach as much as possible the targeted blending ratio between the rainwater and grey water. Of course the GWT should be equipped with a low level pump actuation in order to operate TP if tank is empty.

### Level control in storage tanks

Storage tanks should be equipped with high/low level alarm float switches for pump protection and provide warning of malfunctions. For monitoring purposes tanks should be equipped with level indication systems consisting of a level sensor located in the tank and a level display device located in an easily accessible location. The display device could have lead lights that indicate tank level status.

## HINTS TO CONSIDER

- Aboveground tanks should be opaque to prevent algae growth, UV resistant to prevent tank failure, and piping should be protected against freezing.
- Belowground tanks must be appropriately load-rated for the site (i.e. under a pedestrian area or a parking lot).
- Tanks should be installed according to manufacturers' instructions.
- Only watertight tanks designed for storage should be used
- Tank should not have been used to store any other material.
- Tank should be sized according to the planned RWHCAT and the demand for corresponding USECAT.
- Tank should have an access opening minimum 450mm to facilitate installation, inspection and maintenance of components within the tank.
- For cases where venting by means of conveyance drainage piping and overflow drainage piping is considered insufficient, a vent shall be installed, with a min height of 150mm above grade and no less than 75mm in size equipped with a gooseneck bend and insect screen.

## RAINWATER STORAGE TANK SIZING PROCEDURE

**CASE 1:** Rainwater is used only during the dry season (from May onward)

- If facility water demand for the planned period during the dry season is higher than the possible RWH volume, then tank effective volume should not exceed the corresponding effective surface catchment capacity for an average year.
- If facility water demand for the planned period during the dry season is lower than the possible RWH volume, then tank effective volume should be equal to the facility water demand for the planned period.
- The storage tank nominal volume should be 20% larger than the effective rainwater volume required. Tank physical dimensions are based on the nominal volume.
- If blending with municipality water is contemplated, then RWH tank volume could be cut by half compared to the case of no blending but on the other side a municipality water storage tank needs to be provided and sized according to the procedure shown above.
- If grey water is to be used, then the RWH tank volume could be reduced by the volume of grey water used for irrigation and/or WC flushing.

**CASE 2:** Rainwater is used during the rainy as well as dry season (From December onward)

- If facility water demand for the planned period during the wet and dry season is higher than the possible RWH volume, then tank effective volume should not exceed 60% of the corresponding effective surface catchment capacity for an average year.
- If facility water demand for the planned period during the wet and dry season is lower than the possible RWH volume, then tank effective volume should be equal to the facility water demand for the planned period.
- The storage tank nominal volume should be 20% larger than the effective rainwater volume required. Tank physical dimensions are based on the nominal volume.
- If blending with municipality water is contemplated, then RWH tank volume could be cut by half compared to the case of no blending but on the other side a municipality water storage tank needs to be provided and sized according to the procedure shown above.
- If grey water is to be used, then the RWH tank volume could be reduced by the volume of grey water used for irrigation and/or WC flushing

## HINTS TO CONSIDER

- Tank should be provided with a calming inlet located at the bottom, it is used to direct the entering water upwards to prevent disturbing the fine particulate matter on the bottom of the tank. Calming inlets also introduces oxygen into the bottom of the tank.
- Underground tanks should have a sump for drainage
- Tanks should have an overflow of at least the same diameter as the inlet pipe. Overflow should be routed to the storm network and not the sewer network. Overflow should be trapped if tank is for USECAT1 or USECAT2 applications.

#### 4.4.b Storage Tank Material

Rainwater storage tanks construction could be of different material, such as concrete, masonry, epoxy coated steel, stainless steel, galvanized sheet metal, Polyethylene or fiberglass. The characteristics of the installation such as above or underground configuration, indoors or outdoors, size as well as end use of the stored rainwater do influence the choice of material and type of construction.

**Concrete** tanks are sturdy, provide extreme flexibility in shape, size, configuration and internal design. They could be either cast in situ or prefabricated for above or underground installation. Cast-in-place tanks can be integrated into new construction under a patio or a basement, they will thus form an integral part of the building structure. For existing buildings, adding a concrete tank requires the expertise of a structural engineer to determine the size and spacing of reinforcing steel to match the structural loads. Concrete tanks may be prone to cracking and leaking, especially if built on weak foundations like clay soils. One other advantage of concrete tanks is that they also neutralize the acidity of harvested rainwater and by doing so impart a desirable taste to the water thanks to the dissolved carbonated compounds. For USECAT1 systems, it is essential that the interior of the tank be finished with food grade plaster and paint.

**Polyethylene:** A wide range of selection is available with multiple sizes. They can be used above and below ground

## RAINWATER STORAGE TANKS CONSTRUCTION COULD BE OF DIFFERENT MATERIAL

according to specifications. They exist in single, double and triple layers, with vertical and horizontal models. Fittings on tanks are easily installed. Some models are food grade approved, good for potable water storage.



Underground PE tank



Triple Layer PE Tank



Underground Modular PE tank

**Fig. 26** Polyethylene Tanks

**Stainless Steel type 316** is an excellent choice for USECAT1 applications but pricey, good for above ground applications especially if indoors, however sizes above 8 m<sup>3</sup> may be problematic as far as construction is concerned. The grade of the stainless steel should be carefully selected, many tank manufacturers in Lebanon make claims they do not meet as far as stainless steel tanks are concerned. A bad selection of stainless steel grade or bad workmanship will result in the unpleasant surprise of a corroded tank 6 month after installation.

(Fig.27 shows 3x4 m<sup>3</sup> 316 stainless steel tanks as well as 1x500 liter potable water tank (lower rightmost)  
The overflow (top most pipes) and drainage (lower most pipes

with valves) connections are clearly seen. The pipes above the drain lines are the pump feed lines.



Fig. 27 Stainless Steel Tank

**Galvanized Steel** is cheaper but suffers the same limitations as stainless steel as far as sizes limitations are concerned, moreover

if not properly constructed it will suffer severe corrosion at the seams.

Table 17. Tank Materials Evaluation

	Tank Material	Advantages	Disadvantages
Concrete	Poured in place	Durable	Potential to crack or leak
	Prefabricated	Lasts very long Suitable for Above or Belowground installations Neutralizes acidic rainwater Imparts desirable water taste	Immovable
Plastic	Polyethylene	Commercially available Affordable Available in variety of sizes Easy to install Above or Belowground Little maintenance Triple layer, Insulated, UV resistant & food grade, no coloring inside, maintains pureness of water inside. Underground modules/ unlimited capacity. Alterable & movable	UV degradable Must be painted or tinted
Metal	Stainless Steel 316	Commercially available Little maintenance Alterable & movable	Expensive Size limitations
	Galvanized Steel	Commercially available Alterable & movable	Possible corrosion and rust, that can lead to leaching of metal



Tank should be provided with a calming inlet (fig.28) routed to the tank bottom, it is used to direct the entering water upwards to prevent disturbing the fine particulate matter settled at the bottom of the tank. Calming inlets also introduces oxygen into the bottom layers of the tank.

All tanks should be provided with overflows (fig.29) connected to facility drainage network through a water trap or a positive air break to avoid contamination.

It is preferable that drain inlets be funneled to ease the water flow. Funnel diameter to be three times the overflow pipe diameter.

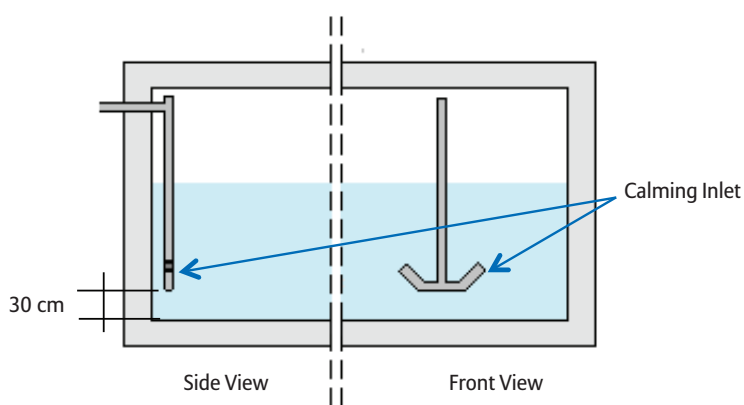


Fig. 28 Calming Inlet

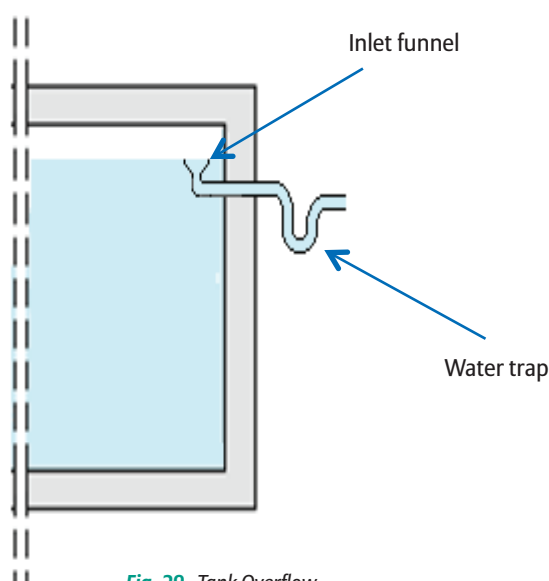


Fig. 29 Tank Overflow

## 4.5 Water Treatment

The general public is often leery about consuming and utilizing rainwater for potable and/or non-potable use, but proper system design with strict implementation and monitoring makes harvested rainwater a safe water source. Crossing the psychological barrier is a real challenge.

The environment, the catchment surface, the conveying network and the storage tanks can affect the quality of harvested rainwater. Unnecessary degradation of collected rainwater can be minimized through good housekeeping but this is not enough if rainwater is to be used for domestic purposes (USECAT1/USECAT2) even if RWHCAT1 catchment surfaces are used.

Water treatment is a complex discipline, however for the purposes of this guideline and the applications involved we can narrow water treatment to few basic components namely straining, sedimentation, filtration, chlorine sterilization, carbon adsorption and UV polishing. These will be discussed here below.

Straining and sedimentation effectively belong to pre-treatment stages. Straining occurs at the first flush tank where relatively large size objects and bulk pollution is removed before reaching the storage tank.

Sedimentation occurs in the storage tank where particles settle to the bottom due to gravity, For sedimentation to be effective, the water body should not be agitated, this is the reason why inlet calmers are devised to minimize water agitation when fresh rainwater enters the tank. Several days are

required for suspended particles to settle down to the tank bottom. Sedimentation can remove up to 80% of the particles entering the tank.

Consequently the storage tank should be cleaned at least once every three years if a first flush tank is used and once every year if a flush tank is not used.

### Pressure filters

The first water treatment stage is filtration; filters could be of different types, for our purpose, only media type pressure filters are used followed by micro filters. Media filters are filled with sand or any other small grain media that retains suspended particles in the water that did not settle in the storage tank like pollen, coarse dust particles, human hair, etc. Media filters remove particles 5 micron and larger, this is practically 95% by weight of all suspended particles and by doing so these filters remove a lot of biological pollutants because these usually adhere to solid particles.

Media Pressure filters could be elongated cylinders or spherical in shape (fig.30).

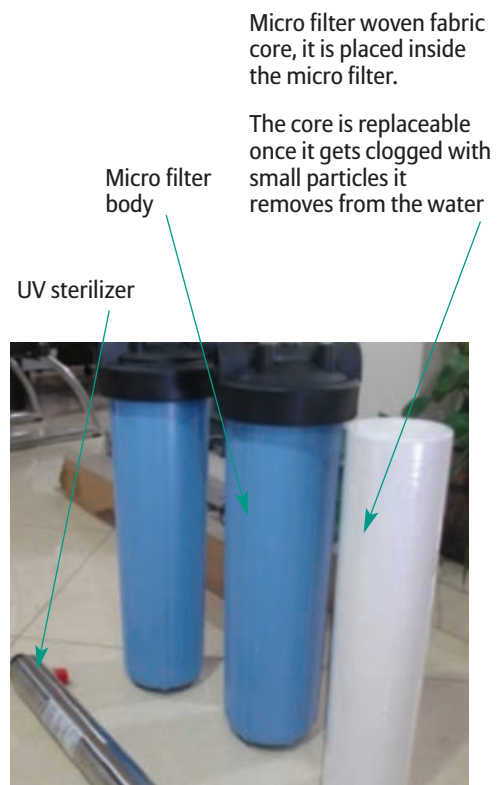
### Micro Filters

Micro filters or cartridge filters are installed downstream of media filters, their task is to remove the fine particles down to 0.5 micron size range that media filters cannot remove. They are made of tightly interwoven natural or synthetic threads that stop very fine dust and other pollutants particles like insecticide dust. For the sake of comparison, the thickness of a human hair is around 100 microns.



Fig. 30 Pressure Filters

## THE STORAGE TANK SHOULD BE CLEANED AT LEAST ONCE EVERY THREE YEARS



Micro filter woven fabric core, it is placed inside the micro filter.

The core is replaceable once it gets clogged with small particles it removes from the water



Fig. 31 Micro Filters

### Chlorine Sterilization

Filters remove solid particles and in the process they remove some bacteriological pollution adhering to these particles, but filters are not designed to remove effectively bacteriological pollution like viruses. This is the job of chlorine sterilization. Usually a solution of sodium hypochlorite is injected in the pipe work upstream of the media filter. For that purpose, a hypochlorite tank (Fig.32, right picture) and a dosing pump (Fig.32, left picture) are used.



Fig. 32 Chlorination dosing pump & Hypochlorite Tank

The injection pump draws the solution from the tank and injects it in the pipework upstream of the blending tank if one is installed. The injected chlorine will sterilize the media filter as well as the micron filter. **Chlorine should never be added in the RWH storage tank. Keeping a 0.1 mg/l concentration of chlorine in the system is recommended at this stage as the water may spend few days in the treated tank or even in the rooftop reservoir if there is one.**

The dosing pump should be interlocked with the RWH storage tank transfer pump as well as with the municipality tank transfer pump if blending is carried out.

At this stage the treated water is fit for domestic use but not for cooking or drinking. The treatment above is satisfactory for USECAT2 if RWHCAT1 or RWHCAT2 is available. The treated water could be stored in a treated water tank preferably made of stainless steel or PE. The treatment discussed above is called first stage treatment in this guideline.

### Carbon filters

As a polishing stage, carbon filters are installed to remove any traces of hydrocarbon pollution like pesticides, sub- micron level particles as well as the remaining chlorine in the water. Carbon filters look exactly like media filters. They may or may not be installed downstream of the first stage treatment.

If some of the product water is to be used for cooking or drinking then a second stage treatment is required. Some of the water is pumped from the treated water tank into another micro filter (on the left of the picture (Fig.34) then passed through an Ultra Violet sterilizer (center of picture with bypass for maintenance purposes) then the water is stored in a potable water tank (The top of the stainless steel potable water tank could be seen at the bottom of the picture) The product water is fit for drinking or cooking purposes. It is now USECAT1. The carbon filter if not installed directly after the first stage treatment could be installed downstream of the micro filter in the second stage. The second option may allow a smaller size carbon filter.

Fig.33 below shows a general view of a first stage treatment with a downstream carbon filter for a RWHCAT2 catchment area destined for a USECAT2.

Raw water from the blending tank enters the first stage water treatment from the right of the picture.

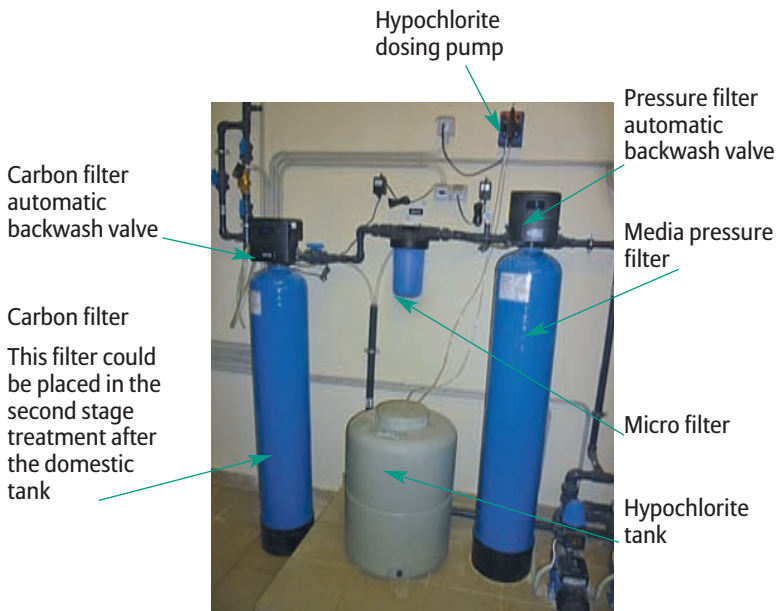


Fig. 33 1<sup>st</sup> Stage Water Treatment Configuration with Down Stream Carbon Filter

Rightmost is the media filter followed by the smaller size micro filter then the carbon filter on the left of the picture. The hypochlorite tank is seen below the micro filter while the hypochlorite dosing pump is fixed to the wall above the media filter. The plastic tubing connecting the hypochlorite dosing pump to the hypochlorite tank is the suction line, while the injection line

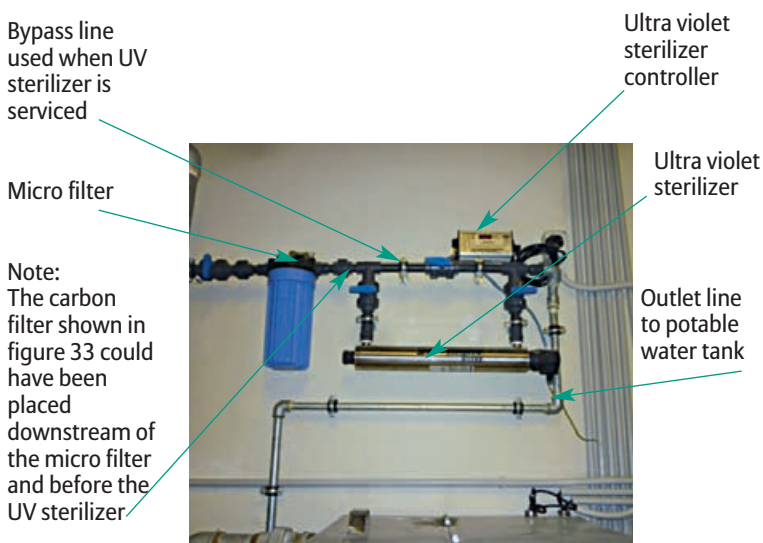


Fig. 34 2<sup>nd</sup> Stage Water Treatment Configuration without Carbon Filter

## IMPORTANT

USECAT1 does not involve only a RWHCAT1 coupled to a WTCAT1 but also a monthly bacteriological testing of a water sample taken from the potable water tap.

could be partly seen at the top right of the picture. It injects chlorine upstream of the media filter in the blending tank (not appearing in the picture). The product water is routed to the domestic water 316 stainless steel tank.

Fig.34 shows a second stage treatment but without carbon polishing which was inserted in the first stage. Water from the domestic tank at the left of the picture enters the micro filter then the UV sterilizer before entering the potable water tank which top is seen in the picture.

- The first and second stages of water treatment described above form WTCAT1.
- WTCAT2 is equivalent to a first stage treatment.
- Carbon filters may be installed after the first stage treatment or they may form part of the second stage treatment depending on preferences. Carbon filters are recommended only if USECAT1 is contemplated.
- WTCAT3 consists basically of the first flush tank and the settling in the storage tank. Consequently WTCAT3 is effectively a pretreatment without filtration or sterilization.

## HINTS TO CONSIDER

Filtration will assist in the prevention of discoloration of plumbing fixtures and is a safeguard against small debris or sediment entering the toilet valves, thus maintaining proper function.

Filtration removes turbidity (cloudiness) which interferes with disinfection.

### 4.5.a Water treatment equipment sizing

In order to size a water treatment installation for RWH, the major parameter to consider is water flow. For optimum efficiency, it is advised not to oversize equipment, this will not improve water quality but may rather give negative results.

#### *Filters selection and sizing*

Filters are sized based on water flow, as an example let us consider House 1 again. The first task consists of sizing the filters of the primary treatment. We have already seen that USECAT1 & USECAT2 for domestic use as well as USECAT2 for irrigation amount to 105 m<sup>3</sup> for 5 month equivalent to 150 days. Consequently the average daily consumption is 0.7 m<sup>3</sup>/day. For all purposes a media filter of 1 m<sup>3</sup>/day will be selected or the nearest available size. The same applies to the cartridge micron filter.

It is recommended to order the media filter with automatic backwash for self-cleaning. Indeed, media filters need to get rid of all the pollutants that accumulate inside the media, this is done by reversing the flow through the media thus the term backwash. The automatic backwash mechanism avoids the hassle of manual backwash every other day. The backwash line should be routed to the drain.

Micron filters are not backwashed, the fabric cartridge inside the filter is simply replaced every six month or depending on clogging. It is therefore recommended to have pressure gages across filters to monitor their state of clogging.

#### *Dosing pumps and chlorination tanks*

The hypochlorite tank is filled with water then liquid sodium hypochlorite solution (15% by weight) is added to reach a concentration of no more than 3% chlorine (by weight) in the hypochlorite tank. In order to reach that concentration, fill a 100 liter hypochlorite tank with 80 liters of water and 20 liters of sodium hypochlorite solution. Hypochlorite tank size should be such that one fill should not last for more than 15 days because chlorine gas goes out of solution. Always use soft water from the RWH tank to fill the hypochlorite tank.

As a rule of thumb, every 1 m<sup>3</sup> of treated domestic water requires 1 liter of hypochlorite solution at a concentration of 3% which is the concentration in the hypochlorite tank. Thus if a house consumes 30 m<sup>3</sup> of treated domestic water per month, a 50 liter solution tank is ideal.

Dosing pumps are also selected based on water flow as shown above, these devices come in standard sizes, one size fits a wide range of water flows. Basically dosing pump flow is 1 liter/day for every 1 m<sup>3</sup>/day of treated water always based on a 3% solution tank concentration.

#### *UV sterilizers*

These also are sized based on flow, UV-C radiation dose should be no less than 40 mj/cm<sup>2</sup> according to class A requirements of the ANSI/NSF standard 55 (ref:23).

#### 4.5.b Water treatment equipment materials

Always use first quality equipment from renowned manufacturers in what relates to water treatment. In order to assure that filters do not leach undesirable contaminants into the water, use filtration systems that have been certified to meet ANSI/NSF Standard 61 requirements (ref:23).

Use sodium hypochlorite compounds that are certified in accordance with ANSI/NSF Standard 60 requirements (ref:23).

Avoid products that contain fragrances and UV stabilizers. Most specifically do not use chlorine compounds designed for use in swimming pools as these products often contain cyanide based UV stabilizers. This guideline does not recommend the use of calcium hypochlorite compounds because it is less stable and may result in maintenance and storage problems.

**Table 18.** Treatment Techniques

	Method	Location	Result
WATER TREATMENT	SCREENING Leaf screens and strainers	Drains, gutters and downspouts	Prevent leaves and other debris from entering tank
	SETTLING Sedimentation	Within Tank	Settles out particulate matter
	FILTERING First Flush diverters	Before tank	Reduces suspended material
	Sand filter	After pump	Sieves sediment
	Carbon Filter/Activated charcoal	After chlorination	Removes chlorine, odors, hydrocarbons, improves taste
DISINFECTING	Chemical treatment/ Chlorine	Within Tank or at pump (liquid or granule), before activated charcoal filter	Kills microorganisms
	Ultraviolet light	After activated charcoal and carbon filters, before storage/tap	Kills microorganisms



## 4.6 Pumps

Pumps are used to move fluids and impart to them the necessary pressure required in any given process. They are of different types and models, In RWHS pumps are vital, therefore a good understanding of the different kinds involved, their functioning and how to select them is very important. Basically a pump for the purpose of this guideline is made of two parts, the pump itself that imparts movement to the fluid and the electric motor that drives the pump.

A pump is characterized by two major operating parameters namely the **flow** and the **head**. The flow as the name implies is the quantity of water handled by the pump per unit time, it is expressed usually as liters/sec or m<sup>3</sup>/hr. The head represents the pressure that could be developed by the pump, it is expressed as Bars or height in meters of water. 1 bar is equivalent to the pressure at the bottom of a column of water 10 meters high. Therefore 1 bar is equivalent to 10 meters head.

### Submersible pumps

As the name implies, these pumps are immersed in the water usually when the storage tank is underground making it difficult to have a side intake. Two kinds of submersible pumps are encountered, the submersible well pump and the submersible pit pump.

Below, is a picture of a submersible well pump showing its main components. As the name implies this type of pump is usually installed in wells which are of

small diameter therefore the water passes along the motor and cools it before entering the pump intake. In case a well pump is to be used in a RWH storage reservoir, then it has to be installed horizontally at the bottom of the tank otherwise much of the storage reservoir volume cannot be pumped and second it needs to have a sleeve around the motor, open only on the motor end to force the water to enter the sleeve and cool the motor. Actually the sleeve replaces the well. It is preferable to connect the open end of the sleeve to a floating suction intake to prevent the suction of dirt from the tank bottom.

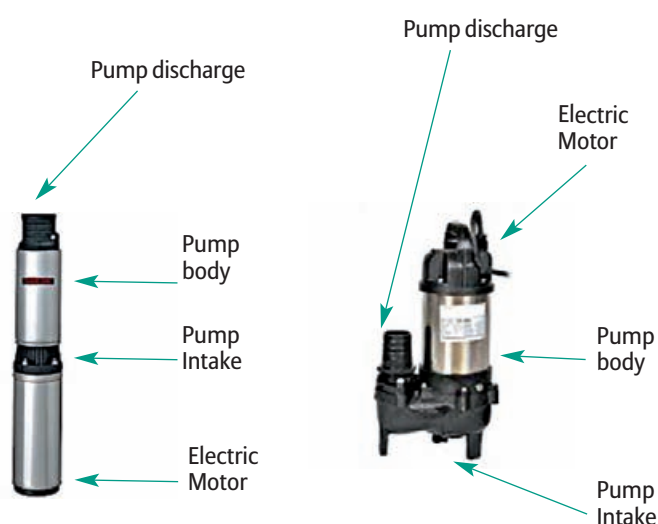


Fig. 35 Submersible Pumps

The other type of submersible pump is the submersible pit pump, as the name implies it is installed in a pit. It does not need a sleeve as it is designed to operate in a tank however its only drawback is that it can generate much less pressure than a submersible well pump and the suction could draw dirt from the tank bottom as it is practically impossible to fit the pump with a floating suction intake. However this issue may be overcome if the pump is installed on a slightly elevated pad.

Both configurations need careful design and to devise practical ways to pull them out of the tank in case repair or maintenance is required while the tank may be full. A definite advantage of submersibles is that they are noiseless.

Float switch for  
submersible  
pump operation

Submersible  
pump

High level alarm  
float switch



Fig. 36 Duplex Submersible Pit Pumps

### Booster Pumps

These are installed external to the tank usually in a mechanical room or an enclosure pit to protect them from the weather and dampen the noise. As fig 36 below shows, booster pumps consist of an electric motor and a pump body. These pumps are also called end suction pumps because they draw water from one end of the pump.

Booster pumps have a wide range of operating characteristics as far as flow and pressure, they are simple to install and service but the drawback is the possible noisy operation if installed nearby living quarters.

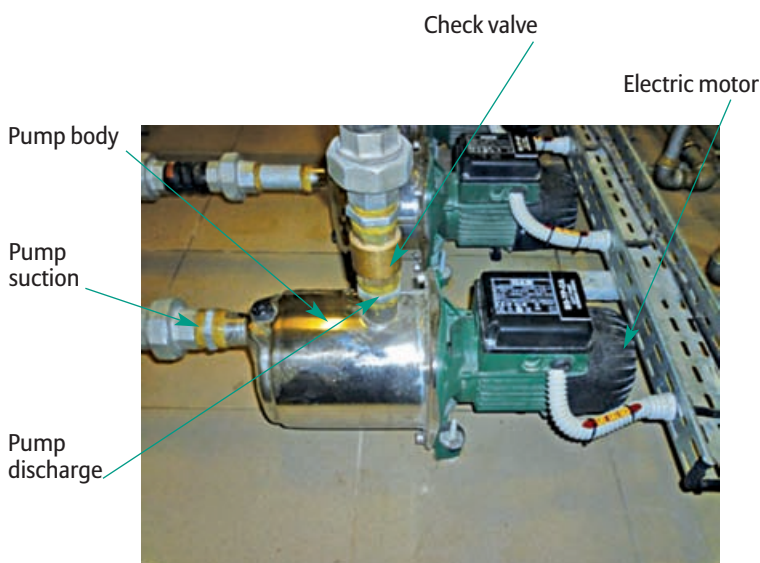


Fig. 37 Horizontal Booster Pump

### Booster set:

It is an assembly made of one (simplex), two (duplex) or three (triplex) booster pumps equipped with a pressure tank and pressure switch to actuate the pumps upon of fall in pressure in the pipework. Booster sets usually supply water to end users so that supply pressure remains fairly constant. This may avoid the unpleasant experience of reduced flow under a shower if other toilets are being used when the network has insufficient pressure.

(Fig.38) shows a duplex booster set complete with a skid rail (below the pumps), the pumps, the stainless steel suction manifold that feed the pumps with water, the pressure actuated variable speed drivers (black boxes above the pumps) and the discharge manifold to which the pressure switch (grey) and pressure tank (red) are connected.

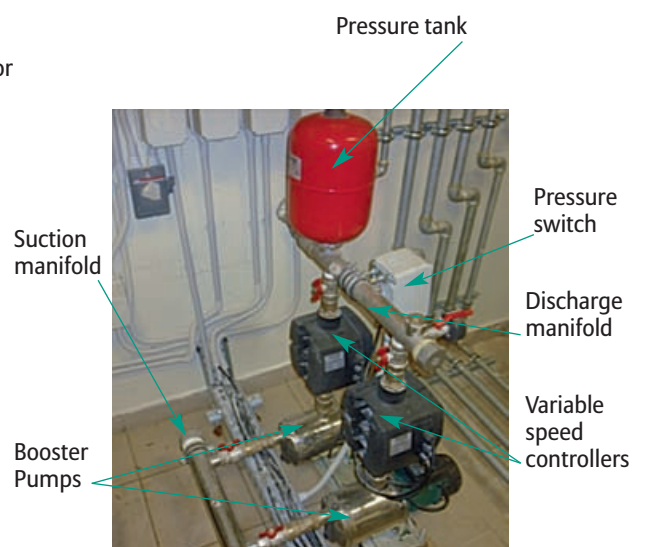


Fig. 38 Duplex Booster set

### Pressure tanks and switches

Pressure switches activate the controls that activate the pump to meet the demand. The size of the pressure tank determines whether your system operates efficiently and effectively. The rule of thumb for sizing a pressure tank is three times the liters/minute of the pump equals the liter size of the pressure tank. Thus if a pump delivers 60 liters/minute the pressure tank size will be 180 liters.

### Pump protection

Should your rainwater cistern become low on water, it will be essential that the pump is protected from running while there is not sufficient water for the pump to function. If the pump continues to run without sufficient water, the pump will be damaged. A simple float switch in the rainwater cistern will protect the pump from running when the water level declines. A float switch automatically resets when the tank refills.

A check valve should be installed at the pump discharge to avoid water backflow which may also damage the pump and empty the discharge line.

In order to protect the pump from erosion and possible jams resulting from fairly big solid particles entrained in the water like rust flakes, small wood pieces, plastics, small pieces of cloth, etc. a strainer should be installed at the pump suction intake.

Flexible connectors should be installed at suction and discharge connections of pump to minimize vibration and noise transmission through piping especially if it is steel.

## PUMPS ARE USED TO MOVE FLUIDS AND IMPART TO THEM THE NECESSARY PRESSURE REQUIRED IN ANY GIVEN PROCESS

### Floating suction intake strainer

To aspirate the water from the tank, a floating intake strainer is located at the end of the pump's suction hose. Sediment, bacteria and other pollutants generally settle to the bottom of the tank, with concentrations of pollutants higher at the bottom than at the surface of the water. Studies have also shown that bacteria levels can be higher at the surface of the cistern water than elsewhere in the tank (ref:23). To avoid these two areas of concern, the floating filter takes water from the tank a few centimeters below the water surface. Floating suction intake strainers seldom clog, they should be made of high-quality stainless steel.



Fig. 39 Booster pump connection details

#### 4.6.a Pump sizing

Pumps are sized using two main parameters, flow and Head. Flow depends on water demand while Head depends on the characteristics of the project like building elevation, distance between storage tank and point of use, type of water treatment equipment, etc.

A rainwater harvesting system network may involve more than one type of pump, therefore each pumping function will be discussed here below.

Starting with the most basic function, namely pumping water from the underground storage tank to a roof tank. Taking House1 as example, we have seen previously that the daily water demand is around 0.75 m<sup>3</sup>/day. Thus the pump needs to raise daily that amount to the roof. But in practice the roof tank may be around 2 m<sup>3</sup> to allow spare reserve for two days in case of a malfunction. If we assume that the pump needs to fill the roof tank in one hour time then the flow will be  $Q = 2 \text{ m}^3/\text{hr}$ , which is a fairly small pump. Having determined the flow, it is now time to compute the head.

(Fig. 40) Below gives a good representation of a widely used installation for lifting water to a higher level from an underground reservoir. The pump is located above the tank and is equipped with a suction line terminated with a foot valve. That valve could be of the floating type.

The head of the pump is the summation of several factors:

- The vertical distance between the pump centerline and the underground tank water surface, the pump needs to "lift" the water over that distance. Usually it is assumed the pump operates in worst case conditions (i.e: an empty tank) thus it is practically distance A expressed in meters.
- The vertical distance the pump needs to push the water, which in worst case conditions is height E between the

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PUMPS ARE SIZED  
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FLOW DEPENDS ON  
WATER DEMAND WHILE  
HEAD DEPENDS ON THE  
CHARACTERISTICS OF  
THE PROJECT

pump centerline and the pipework discharge into the elevated tank expressed in meters.

- The friction between the water in the pipe and the pipe walls which the pump needs to overcome. This friction resistance is also expressed in meters and can be computed once the pipe size, pipe length, pipe type and flow are given. It is expressed as  $H_f$ .
- The head required to operate any end of line device like an automatic valve, a ball valve, etc. in our case we have none. It is expressed as  $H_a$ .

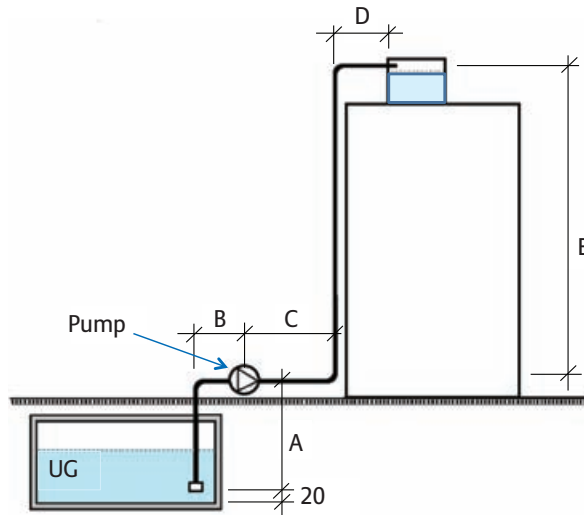


Fig. 40 Underground Reservoir pipework to roof tank in suction lift configuration

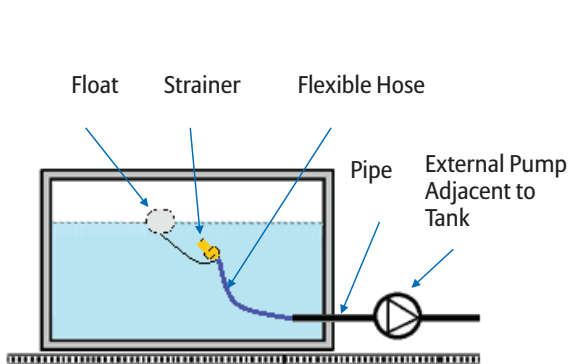


Fig. 40A Reservoir with float strainer in submerged suction configuration

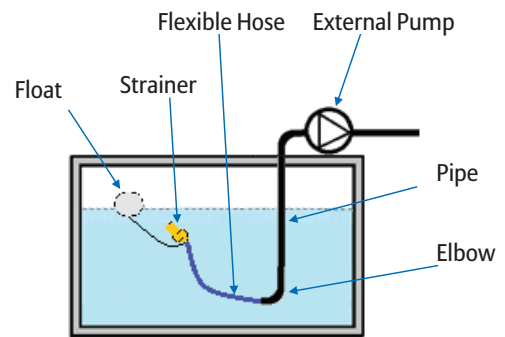


Fig. 40B Reservoir with float strainer in suction lift configuration

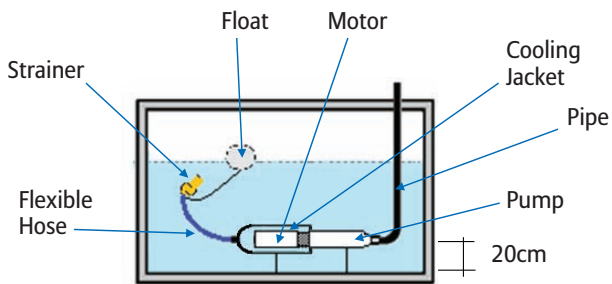


Fig. 40C Reservoir with float strainer in submersible well pump configuration

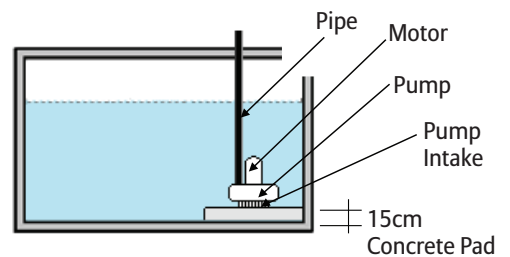


Fig. 40D Reservoir with float strainer in submersible pit pump configuration

The Total Discharge Head (TDH) of the pump is expressed as:

$$T.D.H = A + E + H_f + H_a.$$

A and E are fairly easy to determine, they can be measured from drawings or site. It is important to note that A could be positive or negative depending on the type of configuration. In configurations 40A, 40C and 40D A is negative while in configurations 40 and 40B A is positive. Note that in configurations 40 and 40B, A should never exceed 3 meters as the pump may lose its prime and get damaged.

$H_f$  is the product of the pipe friction factor  $h_f$  determined from Annex E and the overall pipe length. In our case the overall pipe length  $L = A + B + C + E + D$ .

$$\text{Thus } H_f = h_f * L$$

$$H_a \text{ in our case} = 0$$

Assume  $A = 2.5$  meters,  $B = 2$  meters,  $C = 4$  meters,  $E = 18$  meters,  $D = 3.5$  meters.

Then,  $L = 30$  meters.

To find  $h_f$  follow the steps below

- If pipe is exposed or buried, opt for a galvanized steel type. If pipe is protected in a shaft then PPR or PEX is acceptable. Suppose in our case pipe is exposed thus requiring the selection of a Galvanized Steel Pipe (GSP).
- Using the Table in Annex E select pipe size using the hourly flow determined above ( $Q = 2 \text{ m}^3/\text{hr}$  and type of pipe determined in the previous step (GSP). The friction factor  $h_f$  can also be determined. In our case pipe diameter is  $\frac{1}{2}$  inch and  $h_f = 0.038871$

we specify the pipe as GSP, sched 40,  $\varnothing = 3/4$  inch

$$Q = 2 \text{ m}^3/\text{hr}$$

$h_f$  is found to be  $= 0.1913$  then  $H_f = 30 * 0.1913 = 5.7$  meters.

Note that  $h_f$  takes into consideration fittings losses

Therefore  $TDH = 2.5 + 18 + 5.7 = 26.2 \text{ m}$  to be rounded to 27 m

Our pump can now be specified as a booster pump having a flow  $Q = 2 \text{ m}^3/\text{hr}$  at a  $TDH = 27 \text{ m}$ .

Exactly the same calculations would apply for all pumps configurations except that one needs to pay attention to the sign of "A"

Suppose now that the circuit above goes through a filtration unit consisting of a media filter and a micro filter. The pressure drop through the media filter is 0.5 bars when clogged and that of the micro filter is 0.6 bars. Both of them will have an  $H_a = 11$  meters. The pipework length increases from 30 to 45 m because it has to be routed to the mechanical room.

Therefore

$$H_f = 45 * 0.1913 = 8.6 \text{ m}$$

$T.D.H = 2.5 + 18 + 8.6 + 11 = 40.1 \text{ m}$  to be rounded to 41 m

Our pump can now be specified as a booster pump having a flow  $Q = 2 \text{ m}^3/\text{hr}$  at a  $TDH = 41 \text{ m}$ .

Another application to consider is when a booster set feeds water to the building as shown in (fig.41) below. The pump feeds the domestic water network however the Jacuzzi which is two floors below requires 2 bar (the equivalent of 20 m water column) for its operation.



In this case the pump is not lifting water but rather delivering water to lower floors. In this case the TDH could be written as

$$\text{TDH} = -8 + H_f + H_a$$

Where  $H_a = 2$  bars or 20 m head. (-8 is the negative head between the pump and the fixture for which the pressure calculations are required). Whenever the load is below the pump, the lift is negative.

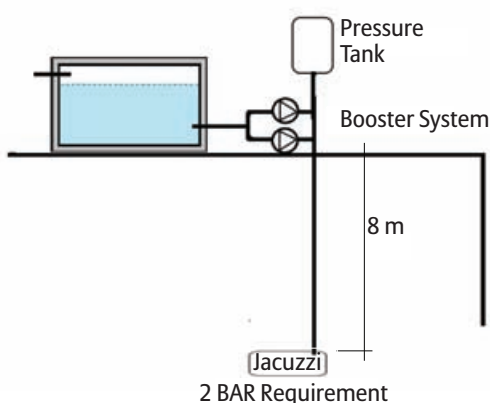
The pump flow requirement is  $0.7 \text{ m}^3/\text{day}$  or  $0.2 \text{ m}^3/\text{hr}$ . To convert from average daily flow to hourly peak flow divide daily flow by 4 in order for the pump to meet peak demand.

Pipe length  $L = 8 \text{ m}$ , considering PPR pipe  $\varnothing 20 \text{ mm}$ ,  $h_f = 0.04$  for  $Q = 0.2 \text{ m}^3/\text{hr}$  as per Annex E.

Consequently

$$\text{TDH} = -8 + 8 \cdot 0.04 + 20 \sim 12 \text{ m}$$

Therefore a duplex booster set with pump characteristics  $Q = 0.2 \text{ m}^3/\text{hr}$  and  $\text{TDH} = 12 \text{ m}$  is to be ordered. The booster set should have an expansion tank of 12 liters.



**Fig. 41** Booster Set feeding the building network

## HINTS TO CONSIDER

- Pump systems should be designed to meet the expected peak demand
- Pumps drawing water from the underwater storage tank should have their intake just below the water surface using a floating intake strainer
- Pumps should not have a suction lift exceeding 3 meters
- Pumps should always have low level cut off to protect them from dry running
- Never oversize pumps, pumps should always operate at their best duty pump
- Always choose pumps from well-known manufacturers
- Pumps should be preferably all stainless steel 316 construction

### 4.6.b Pump Material

Apart from the electric motor, pumps consist mainly of two components, the pump casing and the impeller. The material of construction of the casing and impeller greatly affect the durability and proper operation of the pump. Pump casings could be made of cast iron or 316 stainless steel sheets stampings while the impeller could be bronze, stainless steel stampings or Noryl.

For submersible and booster pumps, it is recommended to choose an all 316 stainless steel construction for all pumps applications related to rainwater. Whenever possible chose a low speed pump 1500 rpm instead of a high speed 3000 rpm, however the pump flow and head may dictate a 3000 rpm pump. Always purchase pumps from well-known manufacturers.

Pumps should always be protected against dry running with low level cut off float switches.

## 5 MAINTENANCE

Careful preventive maintenance by the owner or operator is the best way to assure long trouble free life for the equipment and the highest level of water quality. Common sense and sound installation practices should prevail.

The following maintenance practices are recommended;

- **Every 3 years or less**
  - Clean all tanks, disinfect and flush.
  - Check inner surfaces plaster lining of concrete tanks. If necessary repair lining if cracked or peeling and paint again using appropriate paint.
  - Check submersible pumps in tanks for apparent damage, rust, inlet cogging or damaged electrical cable.
  - Change water treatment filter media if recommended by supplier.
  - Change UV lamp as per manufacturer recommendation.
- **Every year before rainy season check the following**
  - Gutters and drains are not obstructed.
  - No polluting objects on catchment surfaces (dead birds or rodents, organic waste, etc.).
  - First flush tank is clear of debris and cleaned.
  - Strainer of first flush tank is not damaged, if torn or cracked replace.
  - Tree branches and any vegetation that interferes with the gutters or overhangs RWHCAT1 roofs should be pruned.
- **After first rain event that lasts more than 30 minutes**
  - Clean strainer of first flush tank.
  - Clean sump of first flush tank, make sure drain pipe is not clogged.
- **After each torrential rain event**
  - Clean strainer of first flush tank.
  - Clean sump of first flush tank, make sure drain pipe is not clogged.
- **On a 6 month basis**
  - Check cartridge filter of micro filter and replace if clogged.
  - Clean inner part of micro filter housing.
  - Check UV lamp operation as per manufacturer instructions, replace if necessary.
  - Check high/low level alarm float switches operation by operating manually.
  - Check validity of hypochlorite chemicals that are in stock. Hypochlorite chemicals should not be kept in store for more than one year.
  - Check validity of fire extinguishers.

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**CAREFUL PREVENTIVE  
MAINTENANC IS THE  
BEST WAY TO ASSURE  
LONG TROUBLE FREE  
LIFE FOR THE  
EQUIPMENT**

- On a regular basis check the following

- Pumps for abnormal noises or vibrations.
- Any leakage from pipes or above ground tanks.
- Control panels for burned out lamps.
- Liquid level in hypochlorite tanks.
- Clogging of filters.
- Pressure tank gas charge.
- Booster system operation, if booster system is hunting this may mean that pressure tank diaphragm is damaged or pressure tank lost its gas charge.
- Water quality. USECAT1 water should be tested at the tap on a fortnight basis or at most monthly basis.
- Hypochlorite chemicals are not exposed to the sun.
- Technical rooms are clean and well lighted.
- Replace burned light bulbs.
- Quickly wash with abundant water any spill of hypochlorite on your skin.
- Exit lights are properly functioning.
- As a general rule, the cleaner the water going into the cistern, the higher the water quality and the better the system's overall performance will be.
- Maintenance of the UV light involves cleaning of the quartz sleeve and the bulb itself. Some UV lights are designed with an integral wiper unit. Again, follow the manufacturer's instructions and recommendations.

### *Efficient water use practices*

- Close water taps when not used
- Dripping taps should be repaired
- Use water efficient faucets, plumbing fixtures and washing machines
- Use plants and shrubberies adapted to the local weather, it is strongly advised not to plant gazon
- It is strongly advised not to have a swimming pool or a water pond in single family residences
- Do not rinse floors with water, use mops
- Adopt dual plumbing circuits for grey water use

### *Safety and Health*

- Always wear goggles, gloves and dust masks when filling hypochlorite tanks
- Wash with abundant water any part of the body that came in contact with hypochlorite
- Always shut off power on equipment being serviced
- Keep an operating fire extinguisher in the technical room
- Keep a first aid kit in a prominent location in or nearby the technical room
- Post in a prominent place the contact numbers of the nearest medical care center, the red- cross and civil defense
- Make sure technical room floors are always dry and not slippery and objects are not lying on the floor
- Make sure technical rooms are well lighted
- Always use the proper tools for the job
- Use gloves, goggles and ear plugs when using grinder

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# GLOSSARY

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<b>CALMING INLET</b>	A device located at the bottom of a storage tank that permits water to enter a storage tank with minimal disturbance to particles that may have settled to the bottom of the tank.
<b>CATCHMENT SURFACE AREA</b>	Area from which rainwater is collected to be used in a rainwater harvesting system (e.g. roof area).
<b>CODE</b>	Refers to the International Plumbing Code.
<b>DEBRIS EXCLUDER</b>	A screen or other device installed to prevent the accumulation of leaves, needles, or other debris in the system.
<b>DISINFECTION (STERELIZATION)</b>	Reduction of viable microorganisms to a level that is deemed suitable for the intended applications. Typical units of measure are Colony Forming Units per 100ml liter (cfu/100ml).
<b>DOMESTIC WATER</b>	Water for household and commercial areas of use that does not have to have the quality of drinking water.
<b>DRAIN</b>	Collect run off water, they are used mainly for flat surfaces like a flat roof, a terrace or driveway.
<b>DRY RUNNING PROTECTION</b>	System for protecting the water pump against running when no water is present.
<b>FILTRATION</b>	Physical removal of liquid-born contaminants by means of separation from the output flow. Particulate filtration removes suspended particles, measured in units of total suspended solids (TSS), while other forms of filtration, such as carbon/absorption filtration, removes dissolved compounds measured in units of total dissolved solids (TDS).
<b>FIRST FLUSH TANK</b>	A device or method for removal of debris from collection surface by diverting initial rainfall from entry into the cistern / tank.
<b>FLAT</b>	Having a slope no greater than 1 in 50.
<b>FRESH WATER</b>	Naturally occurring water on the Earth's surface; in ice sheets, ice caps, glaciers, icebergs, bogs, ponds, lakes, rivers and streams, and underground as groundwater in aquifers and underground streams. Fresh water is generally characterized by having low concentrations of dissolved salts and other total dissolved solids. Water that infiltrates into the ground and no longer flows across the surface.

<b>GREY WATER</b>	The effluent from lavatories, showers and bathtubs only. WC, washing machines, dish washers, kitchen sink and other plumbing fixtures must not be part of the grey water network.
<b>GROUND WATER</b>	Water that infiltrates into the ground and no longer flows across the surface.
<b>GUTTER</b>	A channel at the eaves or a collector on the sloped roof of a building, for carrying off rainwater.
<b>HARVESTED WATER</b>	Rainwater that is collected in the cistern / tank.
<b>INFILTRATION FIELD</b>	Element in the ground that is filled with gravel, ballast or special non-permeable plastic elements and that stores rainwater that is fed into it on an intermediate basis before the water evaporates into the atmosphere or seeps into the surrounding soil.
<b>LEADER / DOWNSPOUT</b>	Drains are connected to leaders or pipes that convey the water to the storage tank.
<b>MINIMUM WATER VOLUME</b>	Residual water volume that is constrained by the process in which neither sediment nor scum can be sucked in for the protection of the pump.
<b>OVERFLOW LEVEL</b>	The highest level that water in a cistern can rise before flowing out of the tank.
<b>OVERFLOW LINE</b>	Line for leading excess rainwater away when the cistern is full.
<b>PIPING SYSTEM</b>	Pipes that convey the harvested rainwater and distribute it to various fixtures.
<b>PRECIPITATION CHARACTERISTICS</b>	Characteristics of a precipitation event (e.g. intensity, duration).
<b>RAINWATER</b>	Water collected from runoff of roofs or other structures after a rain event.
<b>RAINWATER HARVESTING SYSTEM</b>	Water system for utilizing rainwater, consisting of a cistern/tank, pipe, fittings, pumps and/or other plumbing appurtenances, required for and/or used to harvest and distribute rainwater.
<b>RAINWATER YIELD</b>	Useful water volume (water inflow) determined over a certain period of time.
<b>RETURN ELBOW</b>	A section of pipe with a 180-degree bend.



<b>ROOF DRAINAGE SYSTEM</b>	A system, comprised of roof drains, overflow drains, scuppers, gutters and down spouts, used to convey the rainwater from the roof surface to the tank/cistern.
<b>SCREEN</b>	A filtration device, constructed of corrosion resistant wire or other mesh, having openings in determined areas.
<b>SEDIMENTATION</b>	Separation of solids from the water via gravity.
<b>STRAINER</b>	It is the slotted surface where water enters the drain.
<b>SYSTEM PRESSURE</b>	Pressure needed to deliver water to the designated fixtures.
<b>SLOPED / GABLED ROOF</b>	Having a slope greater than 1 in 50.
<b>SUB-SURFACE IRRIGATION</b>	A method of providing water to plants by raising the water table to the root zone of the crop or by carrying moisture to the root zone by perforated underground pipe. Also known as subirrigation.
<b>SURFACE IRRIGATION</b>	Application of water to the soil by means of pipes or furrows along the surface.
<b>SURFACE WATER</b>	Any rainwater that touches the ground and flows across the surface of the ground (roadway, parking surface, gully, creeks, streams, etc.).
<b>SYSTEM PRESSURE</b>	Pressure needed to deliver water to the designated fixtures.
<b>TANK / CISTERN</b>	The central water storage component of the rainwater harvesting system. Protection and maintenance of the tank is essential for the health of the system.
<b>TRANSPIRATION FIELD</b>	Element in the ground that is filled with gravel, ballast or special permeable plastic elements and that stores rainwater that is fed into it on an intermediate basis before the water seeps into the surrounding soil.
<b>QUANTITY OF PRECIPITATION</b>	Amount of rain, expressed as the water height in millimeters over a horizontal area for a span of time under consideration.
<b>USEFUL VOLUME</b>	Volume that can be completely used during operation (typically 80 – 90% of storage volume).

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# ANNEXES

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ANNEXE A

ANNEXE B

ANNEXE C

ANNEXE D

ANNEXE E

ANNEXE F

ANNEXE G

ANNEXE H

# ANNEX A RAINFALL DATA FOR LEBANESE LOCALITIES

Bekaa	BAALBEK	Houch Barada	حوض بربود	450
Bekaa	BAALBEK	Houch El Nahleh	حوض النحلة	450
Bekaa	BAALBEK	Houch Er Raqqa	حوض الرقعة	450
Bekaa	BAALBEK	laat	لايت	450
Bekaa	BAALBEK	Jabboufe	جبولة	450
Bekaa	BAALBEK	Jdaide	جديدة	450
Bekaa	BAALBEK	Jibaa	جبا	450
Bekaa	BAALBEK	Jinta	جنتا	450
Bekaa	BAALBEK	Joubaniyeh	جوبانية	550
Bekaa	BAALBEK	Kfar Dabach	كفر دابش	450
Bekaa	BAALBEK	Kfar Diane	كفر ديان	450
Bekaa	BAALBEK	Kherbet El Raayeh	خربة الزرعان	700
Bekaa	BAALBEK	Kherbet Raifeg	خربة رايف	450
Bekaa	BAALBEK	Khodor	الخدور	450
Bekaa	BAALBEK	Khormata	خرماتا	450
Bekaa	BAALBEK	Khralbe	الخرية	550
Bekaa	BAALBEK	Knaisse	القبيبة	450
Bekaa	BAALBEK	Laboue	اللبوة	450
Bekaa	BAALBEK	Majlaga	المجلة	450
Bekaa	BAALBEK	Maarboun	معاربون	550
Bekaa	BAALBEK	Majdaloun	مجدلون	450
Bekaa	BAALBEK	Maqne	مقنة	450
Bekaa	BAALBEK	Magr	المغر	450
Bekaa	BAALBEK	Marsous	مسنوس	550
Bekaa	BAALBEK	Mar Charbel	مار خربل	700
Bekaa	BAALBEK	Masnaa Bidnael	مصنع بيدنيل	450
Bekaa	BAALBEK	Masnaa El Zahrah	مصنع الزهراء	700
Bekaa	BAALBEK	Masnaa Ali Millih	مصنع علي مطح	700
Bekaa	BAALBEK	Maraat Beit El Ghoslain	مزارعة بيت الغصن	450
Bekaa	BAALBEK	Maraat Beit Taqch	مزارعة بيت تاقش	450
Bekaa	BAALBEK	Maraat Bou Sleibi	مزارعة بو سلبتي	450
Bekaa	BAALBEK	Maraat El Dahr	مزارع الداهر	450
Bekaa	BAALBEK	Maraat Ed Dallil	مزارع الدليل	450
Bekaa	BAALBEK	Maraat El Siyied	مزارعة السيد	450
Bekaa	BAALBEK	Michairifah	المشيرة	450
Bekaa	BAALBEK	Micharbiye	مشاربية	1000
Bekaa	BAALBEK	Mifajrine	المفاجرين	450
Bekaa	BAALBEK	Miharet Ras Baalbek	مخربة رأس بعلبك	450
Bekaa	BAALBEK	Mirmagha	المرمغة	550
Bekaa	BAALBEK	Mooraq	موراقي	450
Bekaa	BAALBEK	Mraih Abou Ibrahim	مرايح ابو ابراهيم	550
Bekaa	BAALBEK	Mraih Abou Raji	مرايح ابو راجي	450
Bekaa	BAALBEK	Mraih Beit El Qazah	مرايح بيت القزح	450
Bekaa	BAALBEK	Mraih El Aassi	مرايح العاصي	700
Bekaa	BAALBEK	Mraih El Awaj	مرايح العوج	550
Bekaa	BAALBEK	Mraih El Arwajh	مرايح الارواح	550
Bekaa	BAALBEK	Mraih El Ahmar	مرايح الاحمر	550
Bekaa	BAALBEK	Mraih El Bata	مرايح الباتة	450
Bekaa	BAALBEK	Mraih El Chire	مرايح الشير	450
Bekaa	BAALBEK	Mraih El Harfouch	مرايح الحرفوش	450
Bekaa	BAALBEK	Mraih Najib	مرايح نجيب	550
Bekaa	BAALBEK	Mraih El Qloud	مرايح القلود	550
Bekaa	BAALBEK	Mraih Slim	مرايح سلم	450
Bekaa	BAALBEK	Mraih Simaan	مرايح سيمان	550
Bekaa	BAALBEK	Mraih Soular	مرايح سولار	550
Bekaa	BAALBEK	Mraih Wadi El Zrayeb	مرايح وادي الزراب	450
Bekaa	BAALBEK	Mraih Zouaiter	مرايح زعيطر	550

Mouhafaza	Caza	LOCATIONS	الموقع	Rainfall
Beirut	BEIRUT	Beirut	بيروت	710
Bekaa	BAALBEK	Aabla	علا	450
Bekaa	BAALBEK	Aaqidiyeh	العقيدية	450
Bekaa	BAALBEK	Aarsal	عرسال	550
Bekaa	BAALBEK	Aayoun Orghoche	عقراون ارغوشة	700
Bekaa	BAALBEK	Abrouk	ابروك	450
Bekaa	BAALBEK	Ain Ahla	عين احلا	450
Bekaa	BAALBEK	Ain Bourday	عين بورداي	450
Bekaa	BAALBEK	Ain El Jeouze	عين الجوزة	700
Bekaa	BAALBEK	Ain El Bnaye	عين البناية	700
Bekaa	BAALBEK	Ain El Delbeh	عين الدلبية	700
Bekaa	BAALBEK	Ain El Qabou	عين القبو	450
Bekaa	BAALBEK	Ain El Saqa	عين السقا	700
Bekaa	BAALBEK	Ainata	عيناتا	1000
Bekaa	BAALBEK	Alnag	النبح	450
Bekaa	BAALBEK	Barbeik	بعلبك	410
Bekaa	BAALBEK	Barqa	برقا	550
Bekaa	BAALBEK	Bekhousat	بختوت	450
Bekaa	BAALBEK	Bednayeil	بندنيل	450
Bekaa	BAALBEK	Beit Bou Saibi	بيت بو سلبتي	550
Bekaa	BAALBEK	Beit Chama	بيت شاما	410
Bekaa	BAALBEK	Beit Habchi	بيت حبشي	550
Bekaa	BAALBEK	Beit Marar	بيت مزار	550
Bekaa	BAALBEK	Beit Michalik	بيت ميشاليك	550
Bekaa	BAALBEK	Beit Meqlej	بيت مقليج	450
Bekaa	BAALBEK	Bejjajle	بججاية	450
Bekaa	BAALBEK	Beitdahi	بجدي	450
Bekaa	BAALBEK	Bir Aarram	بئر ااررام	450
Bekaa	BAALBEK	Bissailleh	بجسائله	450
Bekaa	BAALBEK	Blaga	بلغة	550
Bekaa	BAALBEK	Boudai	بوداي	450
Bekaa	BAALBEK	Brihel	بريهل	450
Bekaa	BAALBEK	Chaalbe	الشعبية	700
Bekaa	BAALBEK	Chaat	شعت	450
Bekaa	BAALBEK	Chamshariyeh	الشمشورية	450
Bekaa	BAALBEK	Chilfa	شيفا	405
Bekaa	BAALBEK	Chmistar	شمسطار	450
Bekaa	BAALBEK	Dar el Ouassaa	دار الواسا	1000
Bekaa	BAALBEK	Dawret El Namel	دار النمل	700
Bekaa	BAALBEK	Deir El Ahmar	دير الاحمر	510
Bekaa	BAALBEK	Douris	دوريس	350
Bekaa	BAALBEK	El Ain	العين	450
Bekaa	BAALBEK	Fakehe	الفقيه	350
Bekaa	BAALBEK	Flouji	فلوجي	450
Bekaa	BAALBEK	Hadet	الحدت	450
Bekaa	BAALBEK	Halbata	حلبتا	450
Bekaa	BAALBEK	Ham	حمم	700
Bekaa	BAALBEK	Haouch Ed Dahab	حوض الذهب	450
Bekaa	BAALBEK	Haouch En Nabi	حوض النبي	450
Bekaa	BAALBEK	Haouch Snaid	حوض سنيد	450
Bekaa	BAALBEK	Haouch Tall Saifiye	حوض تال صفيية	450
Bekaa	BAALBEK	Haour Taala	حور تالا	450
Bekaa	BAALBEK	Harata	حراطا	450
Bekaa	BAALBEK	Hafayer	الحفayer	450
Bekaa	BAALBEK	Hay El Marfaneh	حي المرفانه	450
Bekaa	BAALBEK	Hizine	حزون	450



RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Bekaa	BAALBEK	Yountine	لوتين	450
Bekaa	BAALBEK	Zabboud	زبؤد	450
Bekaa	BAALBEK	Zarayeb	الزرايب	1000
Bekaa	BAALBEK	Zriri	الزيري	450
Bekaa	BAALBEK	Zrazir	الزرازيير	450
Bekaa	HERMEL	Ain El Tifeha	عين التيفحة	250
Bekaa	HERMEL	Barghach	بزرغش	250
Bekaa	HERMEL	Babou	بابؤا	250
Bekaa	HERMEL	Bdita	بديتا	250
Bekaa	HERMEL	Belt Aallam	بيت علالم	250
Bekaa	HERMEL	Belt Aallouh	بيت علاؤه	250
Bekaa	HERMEL	Belt Hira	بيت هيرا	250
Bekaa	HERMEL	Belt El Sammaqa	بيت السماقا	250
Bekaa	HERMEL	Bouaida	بؤيداء	250
Bekaa	HERMEL	Boustane	بؤستان	250
Bekaa	HERMEL	Brailj	البرايج	250
Bekaa	HERMEL	Brisa	بريسا	250
Bekaa	HERMEL	Byout El Ain	بؤوت العين	250
Bekaa	HERMEL	Chammis El Tourkmane	شميس التوركمان	250
Bekaa	HERMEL	Charbine	الشاربين	250
Bekaa	HERMEL	Charbine El Fawqa	الشاربين الفوقا	250
Bekaa	HERMEL	Chlimeh	الشلهم	250
Bekaa	HERMEL	Chouaghir	الشؤاغير	250
Bekaa	HERMEL	Chouaghir El Tahta	الشؤاغير التاhta	250
Bekaa	HERMEL	Dair Mar Maroun	دير مار مارؤن	250
Bekaa	HERMEL	Dawra	الداؤرة	250
Bekaa	HERMEL	Faarah	فاؤره	250
Bekaa	HERMEL	Fissane	فيسان	250
Bekaa	HERMEL	Hachouch Es Saliyad Abli	حؤوش السلياطي	250
Bekaa	HERMEL	Harit El Maasir	حارة الماسير	250
Bekaa	HERMEL	Hariqa	الهريقة	250
Bekaa	HERMEL	Hawch Beit Ismail	حؤوش بيت السماعيل	250
Bekaa	HERMEL	Hawchariyeh	حؤوشيرة	250
Bekaa	HERMEL	Hermel	الهرمل	250
Bekaa	HERMEL	Himalire	الهميرة	250
Bekaa	HERMEL	Jawz	الجؤز	250
Bekaa	HERMEL	Jbab El Homor	جباب الهمؤر	250
Bekaa	HERMEL	Jiser El Assi	جيسر العاصي	250
Bekaa	HERMEL	Jour El Hachich	جؤار الحاشيش	250
Bekaa	HERMEL	Kharayeb	الكارايب	250
Bekaa	HERMEL	Kouakh	القؤاخ	250
Bekaa	HERMEL	Maaisr	معايسر	250
Bekaa	HERMEL	Maaljeit Job	معالجيت جؤاب	250
Bekaa	HERMEL	Mahlisa	مهليسا	250
Bekaa	HERMEL	Marjhine	مارجحين	250
Bekaa	HERMEL	Mzraat Ain El Zarga	مزرعة عين الزؤرا	250
Bekaa	HERMEL	Mzraat Beit El Tochim	مزرعة بيت الطعم	250
Bekaa	HERMEL	Mzraat El Taleh	مزرعة التله	250
Bekaa	HERMEL	Mzraat Sojod	مزرعة سؤؤد	250
Bekaa	HERMEL	Mdawich	مداؤش	250
Bekaa	HERMEL	Mnalra	المنلراء	250
Bekaa	HERMEL	Mrah Abbas	مراؤ عباس	250
Bekaa	HERMEL	Mrah Beit Aalawh	مراؤ بيت علاؤه	250
Bekaa	HERMEL	Mrah Beit Ouawh	مراؤ بيت عؤاد	250
Bekaa	HERMEL	Mrah Bldach	مراؤ بلكاش	250
Bekaa	HERMEL	Mrah Bou Handal	مراؤ بؤ حنطال	250
Bekaa	HERMEL	Mrah Bou Kamar El Din	مراؤ بؤ كامار الدين	250

Bekaa	BAALBEK	Nabaa El Litani	نابع الليطاني	450
Bekaa	BAALBEK	Nabha	نابها	450
Bekaa	BAALBEK	Nabha El Qeddam	نابها القدام	450
Bekaa	BAALBEK	Nabi Bertha	نابي بئرثا	450
Bekaa	BAALBEK	Nabi Chit	نابي شيت	450
Bekaa	BAALBEK	Nabi Ismail	نابي السماعيل	700
Bekaa	BAALBEK	Nabi Osmane	نابي عثمان	450
Bekaa	BAALBEK	Nabi Rachade	نابي رشاد	450
Bekaa	BAALBEK	Nabi Saleh	نابي صالح	550
Bekaa	BAALBEK	Nabi Sbat	نابي سبؤا	700
Bekaa	BAALBEK	Nabi Sraji	نابي سؤرايج	700
Bekaa	BAALBEK	Nahle	نابها	450
Bekaa	BAALBEK	Naqra	نقرا	550
Bekaa	BAALBEK	Qara	قارا	450
Bekaa	BAALBEK	Qarha	قارها	450
Bekaa	BAALBEK	Qasr El Bonat	قصر البؤات	450
Bekaa	BAALBEK	Qasr El Lajouj	قصر اللؤؤج	550
Bekaa	BAALBEK	Qiddam (el)	قادر	700
Bekaa	BAALBEK	Qlid El Sabaa	قلايد السباع	450
Bekaa	BAALBEK	Qlailah	قلايله	700
Bekaa	BAALBEK	Qourtara	قؤؤتارا	550
Bekaa	BAALBEK	Qsamaba	قسمابا	450
Bekaa	BAALBEK	Ram	رام	450
Bekaa	BAALBEK	Ras Basalbek	راس بؤسلك	450
Bekaa	BAALBEK	Ras El Aassi	راس العاصي	450
Bekaa	BAALBEK	Ras El Ain	راس العين	450
Bekaa	BAALBEK	Rasim El Hadet	راسيم الحدت	450
Bekaa	BAALBEK	Riha	ريها	450
Bekaa	BAALBEK	Saaidie	السؤيدة	450
Bekaa	BAALBEK	Saira	سائرا	450
Bekaa	BAALBEK	Saidet El Najat	سؤيدت الناجت	700
Bekaa	BAALBEK	Saraain el Faouqa	سارائين الفوقا	520
Bekaa	BAALBEK	Saraain et Tahta	سارائين التاhta	450
Bekaa	BAALBEK	Soubba	سؤؤبا	450
Bekaa	BAALBEK	Sifri	سؤفري	450
Bekaa	BAALBEK	Siret Hana	سؤريت هانا	550
Bekaa	BAALBEK	Souwanieh	سؤؤوانيه	450
Bekaa	BAALBEK	Tahoun El Motran	طاهؤن المؤوران	450
Bekaa	BAALBEK	Talbe	الطبيه	450
Bekaa	BAALBEK	Tal El Aalaliq	طال العالليق	450
Bekaa	BAALBEK	Tal El Mesoudiyeh	طال المسؤديه	450
Bekaa	BAALBEK	Tal Sougha	طال سؤؤغا	450
Bekaa	BAALBEK	Talet El Dair	طاله الدير	450
Bekaa	BAALBEK	Tallia	طالبا	450
Bekaa	BAALBEK	Tammine et Tahia	تلمين التما	450
Bekaa	BAALBEK	Tammine El Faouqa	تلمين الفوقا	450
Bekaa	BAALBEK	Taraiya	تارايا	450
Bekaa	BAALBEK	Tifail	الطافق	700
Bekaa	BAALBEK	Tibchar	تيبشار	450
Bekaa	BAALBEK	Tlailih	الطلايه	450
Bekaa	BAALBEK	Toufqiye	تؤؤفيقه	450
Bekaa	BAALBEK	Wadi El hjara	وادي الحجارة	450
Bekaa	BAALBEK	Yahfoura	ياؤفؤرا	450
Bekaa	BAALBEK	Yammoune	اليامؤنة	1010
Bekaa	BAALBEK	Yanabaa El Yamouneh	ياناباع اليامؤنة	1010

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Bekaa	RACHAÏYA	Deir el Aachayer	نهر العياض	917
Bekaa	RACHAÏYA	El Aaqbeh	العياض	917
Bekaa	RACHAÏYA	El Faqaa	فاقعة	917
Bekaa	RACHAÏYA	El Mraoh	المرأة	917
Bekaa	RACHAÏYA	El Mrooj	المروج	917
Bekaa	RACHAÏYA	El Nabaat	النبات	917
Bekaa	RACHAÏYA	Hakouh	حجرة	917
Bekaa	RACHAÏYA	Hsouh	الحوش	917
Bekaa	RACHAÏYA	Hawth Hafouna	حوش حافونا	917
Bekaa	RACHAÏYA	Jabal El Cheikh	جبل الشيخ	917
Bekaa	RACHAÏYA	Job Farah	جوب فرح	917
Bekaa	RACHAÏYA	Kaoukaba	كوكبا	917
Bekaa	RACHAÏYA	Kfar Danis	كفر دنيس	917
Bekaa	RACHAÏYA	Kfar Mechli	كفر مكي	917
Bekaa	RACHAÏYA	Kfar Oluq	كفر لوق	845
Bekaa	RACHAÏYA	Khibet Rouha	خربة زوحا	917
Bekaa	RACHAÏYA	Majdal Balhis	مجدل بلهيس	917
Bekaa	RACHAÏYA	Mari El Samah	مزرع السامح	917
Bekaa	RACHAÏYA	Maraat Aazeh	مزرعة عزة	917
Bekaa	RACHAÏYA	Maraat El Chammissah	مزرعة الشامية	917
Bekaa	RACHAÏYA	Maraat El Yabssiyyeh	مزرعة الياسية	917
Bekaa	RACHAÏYA	Maraat Jaafar	مزرعة جعفر	917
Bekaa	RACHAÏYA	Maraat Silsita	مزرعة سلسيتا	917
Bekaa	RACHAÏYA	Mdoukha	مدوكا	917
Bekaa	RACHAÏYA	Mhalise	المهلية	917
Bekaa	RACHAÏYA	Mrah El Qadi	مزرع القاضي	917
Bekaa	RACHAÏYA	Mraimis	مرايميس	917
Bekaa	RACHAÏYA	Nabi Safa	النبي صفا	917
Bekaa	RACHAÏYA	Qarabou	القروون	732
Bekaa	RACHAÏYA	Qamaabeh	قماية	730
Bekaa	RACHAÏYA	Rachaiya	راشيا	860
Bekaa	RACHAÏYA	Rafid	الريف	917
Bekaa	RACHAÏYA	Tal Bijeh	تل بيجة	917
Bekaa	RACHAÏYA	Tammoura	تامورة	917
Bekaa	RACHAÏYA	Toukita	طركيتا	917
Bekaa	RACHAÏYA	Wadi Ghar El Jamous	وادي غار الجموس	917
Bekaa	RACHAÏYA	Yania	يانيا	917
Bekaa	WEST BEKAA	Aamiq	عقيق	870
Bekaa	WEST BEKAA	Aana	عانا	870
Bekaa	WEST BEKAA	Ain El Falouj	عين الفلوج	870
Bekaa	WEST BEKAA	Ain El Tineh	عين التينة	870
Bekaa	WEST BEKAA	Ain el Tineh	عين التينة	870
Bekaa	WEST BEKAA	Ain Zebde	عين زبدة	870
Bekaa	WEST BEKAA	Aitanit	عيتيت	870
Bekaa	WEST BEKAA	Baaloul	بعلول	1,050
Bekaa	WEST BEKAA	Bab Marza	باب مزرع	870
Bekaa	WEST BEKAA	Beit El Badawiyyeh	بيت البادية	870
Bekaa	WEST BEKAA	Beit Fares	بيت فارس	870
Bekaa	WEST BEKAA	Bouhairit El Qaroun	بجيرة القرون	870
Bekaa	WEST BEKAA	Chebrejye	الشبرجة	870
Bekaa	WEST BEKAA	Dakoue	الداكة	870
Bekaa	WEST BEKAA	Deir Ain el Jaroute	دير عين جوزة	870
Bekaa	WEST BEKAA	Deir Tahnich	دير طحنيان	870
Bekaa	WEST BEKAA	Dilafti	دلافي	870
Bekaa	WEST BEKAA	El Chara	الشجرة	870
Bekaa	WEST BEKAA	El Chammiss	الشاميس	870
Bekaa	WEST BEKAA	El Cheikh Hassan El Marij	الشيخ حسن المريج	870

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Bekaa	HERMEL	Mirah Daher El Chir	مزرع صهيح النهر	250
Bekaa	HERMEL	Mirah El Aaqbeh	مزرع العياض	250
Bekaa	HERMEL	Mirah El Aatalbeh	مزرع العياض	250
Bekaa	HERMEL	Mirah El Abb	مزرع العياض	250
Bekaa	HERMEL	Mirah El Ain	مزرع العياض	250
Bekaa	HERMEL	Mirah El Arab	مزرع العرب	250
Bekaa	HERMEL	Mirah El Chaeib	مزرع الشيب	250
Bekaa	HERMEL	Mirah El Chammiss	مزرع الشاميس	250
Bekaa	HERMEL	Mirah El Dallil	مزرع الدليل	250
Bekaa	HERMEL	Mirah El Mahlisa	مزرع المهلصة	250
Bekaa	HERMEL	Mirah El Mechnif	مزرع المشرف	250
Bekaa	HERMEL	Mirah El Moughir	مزرع المنقر	250
Bekaa	HERMEL	Mirah El Naher	مزرع النهر	250
Bekaa	HERMEL	Mirah El Nawas	مزرع النواص	250
Bekaa	HERMEL	Mirah El Qoraineh	مزرع القرينة	250
Bekaa	HERMEL	Mirah El Syyed	مزرع السيد	250
Bekaa	HERMEL	Mirah El Zaarouf	مزرع الزوروف	250
Bekaa	HERMEL	Mirah El Zikbeh	مزرع الزيجة	250
Bekaa	HERMEL	Mirah El Zwanib	مزرع الزوانيب	250
Bekaa	HERMEL	Mirah Eltas	مزرع الحياض	250
Bekaa	HERMEL	Mirah Houssain Taan	مزرع حسان طعان	250
Bekaa	HERMEL	Mirah Seljouid	مزرع سلجود	250
Bekaa	HERMEL	Mirah Yassine	مزرع ياسين	250
Bekaa	HERMEL	Nasriyye	نصيرية	250
Bekaa	HERMEL	Quadi el Oss	وادي العس	250
Bekaa	HERMEL	Quadi El Rable	وادي الربلة	250
Bekaa	HERMEL	Quadi et Tourfameine	وادي الترفان	250
Bekaa	HERMEL	Qanafez	قنافة	250
Bekaa	HERMEL	Qasar	القصر	250
Bekaa	HERMEL	Qlid El Diab	قلد الدياب	250
Bekaa	HERMEL	Qorneh	قرنة	250
Bekaa	HERMEL	Qornit Bassil	قرنة باسيل	250
Bekaa	HERMEL	Quadi Brit	وادي بيت	250
Bekaa	HERMEL	Quadi Faara	وادي فارة	250
Bekaa	HERMEL	Sahlit El Mb	سهلات الماء	250
Bekaa	HERMEL	Souaisse	سوايسة	250
Bekaa	HERMEL	Swa-dia	السويدية	250
Bekaa	HERMEL	Tal El Far	تل الفار	250
Bekaa	HERMEL	Wadi El Karm	وادي الكرم	250
Bekaa	HERMEL	Zighine	الزغرين	250
Bekaa	HERMEL	Zighine El Tahta	زغرين تحتها	250
Bekaa	HERMEL	Zwailineh	الزوايلية	250
Bekaa	RACHAÏYA	Aaiha	عجا	917
Bekaa	RACHAÏYA	Aaqbe	العياض	917
Bekaa	RACHAÏYA	Ain Aarab	عين عرب	917
Bekaa	RACHAÏYA	Ain Aata	عين عطا	917
Bekaa	RACHAÏYA	Ain El Aalaq	عين الحلق	917
Bekaa	RACHAÏYA	Alta el Foukhar	عطا الفخار	917
Bekaa	RACHAÏYA	Balkka	بلكا	917
Bekaa	RACHAÏYA	Balkifa	بلكفا	917
Bekaa	RACHAÏYA	Beit Lahia	بيت لاهيا	917
Bekaa	RACHAÏYA	Bire	البيرة	917
Bekaa	RACHAÏYA	Chammiss El Hami	شاميس الهامي	917
Bekaa	RACHAÏYA	Dair el Ahmar	صهيح الاحمر	917



RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Bekaa	WEST BEKAA	El Jabara	الجابرة	870
Bekaa	WEST BEKAA	El Kharalib	الخراب	870
Bekaa	WEST BEKAA	El Marj	المرج	870
Bekaa	WEST BEKAA	El Nassar	النصار	870
Bekaa	WEST BEKAA	El Rawda	الروضة	870
Bekaa	WEST BEKAA	Fadâr el Faouqa	فادار القوقا	1,050
Bekaa	WEST BEKAA	Fadâr el Tahia	فادار التاهيا	870
Bekaa	WEST BEKAA	Ghazze	غزة	870
Bekaa	WEST BEKAA	Hammarra	حمارة	870
Bekaa	WEST BEKAA	Hawch Aamiq	حوش اعقيق	870
Bekaa	WEST BEKAA	Hawch el Harime	حوش الحارمة	870
Bekaa	WEST BEKAA	Hawch El Sealtouk	حوش السعلوك	870
Bekaa	WEST BEKAA	Jabal Bir El Daher	جبل بئر الداهر	1,050
Bekaa	WEST BEKAA	Joub Jannine	جوت جنين	715
Bekaa	WEST BEKAA	Jwar Qourqoumaz	جوار قرقوماز	870
Bekaa	WEST BEKAA	Kafraya	كفريا	870
Bekaa	WEST BEKAA	Kamed el Laouz	كامل القوز	870
Bekaa	WEST BEKAA	Khiara	الخبارة	870
Bekaa	WEST BEKAA	Khribet Qanafar	خربة قنفار	870
Bekaa	WEST BEKAA	Lala	لالا	1,050
Bekaa	WEST BEKAA	Lubbaya	للبيا	1,050
Bekaa	WEST BEKAA	Loussia	لوسيا	870
Bekaa	WEST BEKAA	Machgara	مشغرة	1,440
Bekaa	WEST BEKAA	Mandara	المنارة	1,050
Bekaa	WEST BEKAA	Manoura	المنورة	620
Bekaa	WEST BEKAA	Mesidoun	ميدون	870
Bekaa	WEST BEKAA	Mrah El Bacha	مرح البشا	1,050
Bekaa	WEST BEKAA	Nabea El Khrizat	نابعا الخريزات	870
Bekaa	WEST BEKAA	Nabi Noun	نابي نون	870
Bekaa	WEST BEKAA	Nabi Zraiq	نابي زرايق	1,050
Bekaa	WEST BEKAA	Qararoun	القرون	560
Bekaa	WEST BEKAA	Qilya	قيا	870
Bekaa	WEST BEKAA	Sahrinj	سهرنج	870
Bekaa	WEST BEKAA	Saghbine	سغبين	1,050
Bekaa	WEST BEKAA	Sohmor	سحمر	870
Bekaa	WEST BEKAA	Souaini	السوايني	870
Bekaa	WEST BEKAA	Soultane Yaacoub el Faouqa	السولتان يعقوب القوقا	870
Bekaa	WEST BEKAA	Tall El Zaazaa	تل الزعازع	1,050
Bekaa	WEST BEKAA	Tall Znoub	تل زنوب	870
Bekaa	WEST BEKAA	Tall Znoub El Jdidéh	تل زنوب الجديدة	870
Bekaa	WEST BEKAA	Yohmor el Bekaa	يخمر	870
Bekaa	WEST BEKAA	Zellaya	زليا	870
Bekaa	ZAHLE	Aali en Nahri	عالي النهرى	690
Bekaa	ZAHLE	Anjar	انجر	690
Bekaa	ZAHLE	Ablah	ابلاخ	690
Bekaa	ZAHLE	Aln El Aasal	عن العسل	1,000
Bekaa	ZAHLE	Aln Kfar Zabad	عن كفر زباد	690
Bekaa	ZAHLE	Aln Jabbour	عن جبار	690
Bekaa	ZAHLE	Aln Jahaaf	عن جحاف	690
Bekaa	ZAHLE	Bar Elias	بار إلياس	690
Bekaa	ZAHLE	Beit Mbarak	بيت مبارك	690
Bekaa	ZAHLE	Bhana	بخنا	1,000
Bekaa	ZAHLE	Bouarej	بوارج	1,000
Bekaa	ZAHLE	Chaura	شوره	840
Bekaa	ZAHLE	Dahr Blit	دهر تليلد	690
Bekaa	ZAHLE	Dahr el Baydar	دهر البيدر	1,000

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Bekaa	WEST BEKAA	El Jabara	الجابرة	870
Bekaa	WEST BEKAA	El Kharalib	الخراب	870
Bekaa	WEST BEKAA	El Marj	المرج	870
Bekaa	WEST BEKAA	El Nassar	النصار	870
Bekaa	WEST BEKAA	El Rawda	الروضة	870
Bekaa	WEST BEKAA	Fadâr el Faouqa	فادار القوقا	1,050
Bekaa	WEST BEKAA	Fadâr el Tahia	فادار التاهيا	870
Bekaa	WEST BEKAA	Ghazze	غزة	870
Bekaa	WEST BEKAA	Hammarra	حمارة	870
Bekaa	WEST BEKAA	Hawch Aamiq	حوش اعقيق	870
Bekaa	WEST BEKAA	Hawch el Harime	حوش الحارمة	870
Bekaa	WEST BEKAA	Hawch El Sealtouk	حوش السعلوك	870
Bekaa	WEST BEKAA	Jabal Bir El Daher	جبل بئر الداهر	1,050
Bekaa	WEST BEKAA	Joub Jannine	جوت جنين	715
Bekaa	WEST BEKAA	Jwar Qourqoumaz	جوار قرقوماز	870
Bekaa	WEST BEKAA	Kafraya	كفريا	870
Bekaa	WEST BEKAA	Kamed el Laouz	كامل القوز	870
Bekaa	WEST BEKAA	Khiara	الخبارة	870
Bekaa	WEST BEKAA	Khribet Qanafar	خربة قنفار	870
Bekaa	WEST BEKAA	Lala	لالا	1,050
Bekaa	WEST BEKAA	Lubbaya	للبيا	1,050
Bekaa	WEST BEKAA	Loussia	لوسيا	870
Bekaa	WEST BEKAA	Machgara	مشغرة	1,440
Bekaa	WEST BEKAA	Mandara	المنارة	1,050
Bekaa	WEST BEKAA	Manoura	المنورة	620
Bekaa	WEST BEKAA	Mesidoun	ميدون	870
Bekaa	WEST BEKAA	Mrah El Bacha	مرح البشا	1,050
Bekaa	WEST BEKAA	Nabea El Khrizat	نابعا الخريزات	870
Bekaa	WEST BEKAA	Nabi Noun	نابي نون	870
Bekaa	WEST BEKAA	Nabi Zraiq	نابي زرايق	1,050
Bekaa	WEST BEKAA	Qararoun	القرون	560
Bekaa	WEST BEKAA	Qilya	قيا	870
Bekaa	WEST BEKAA	Sahrinj	سهرنج	870
Bekaa	WEST BEKAA	Saghbine	سغبين	1,050
Bekaa	WEST BEKAA	Sohmor	سحمر	870
Bekaa	WEST BEKAA	Souaini	السوايني	870
Bekaa	WEST BEKAA	Soultane Yaacoub el Faouqa	السولتان يعقوب القوقا	870
Bekaa	WEST BEKAA	Tall El Zaazaa	تل الزعازع	1,050
Bekaa	WEST BEKAA	Tall Znoub	تل زنوب	870
Bekaa	WEST BEKAA	Tall Znoub El Jdidéh	تل زنوب الجديدة	870
Bekaa	WEST BEKAA	Yohmor el Bekaa	يخمر	870
Bekaa	WEST BEKAA	Zellaya	زليا	870
Bekaa	ZAHLE	Aali en Nahri	عالي النهرى	690
Bekaa	ZAHLE	Anjar	انجر	690
Bekaa	ZAHLE	Ablah	ابلاخ	690
Bekaa	ZAHLE	Aln El Aasal	عن العسل	1,000
Bekaa	ZAHLE	Aln Kfar Zabad	عن كفر زباد	690
Bekaa	ZAHLE	Aln Jabbour	عن جبار	690
Bekaa	ZAHLE	Aln Jahaaf	عن جحاف	690
Bekaa	ZAHLE	Bar Elias	بار إلياس	690
Bekaa	ZAHLE	Beit Mbarak	بيت مبارك	690
Bekaa	ZAHLE	Bhana	بخنا	1,000
Bekaa	ZAHLE	Bouarej	بوارج	1,000
Bekaa	ZAHLE	Chaura	شوره	840
Bekaa	ZAHLE	Dahr Blit	دهر تليلد	690
Bekaa	ZAHLE	Dahr el Baydar	دهر البيدر	1,000

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Bekaa	WEST BEKAA	El Jabara	الجابرة	870
Bekaa	WEST BEKAA	El Kharalib	الخراب	870
Bekaa	WEST BEKAA	El Marj	المرج	870
Bekaa	WEST BEKAA	El Nassar	النصار	870
Bekaa	WEST BEKAA	El Rawda	الروضة	870
Bekaa	WEST BEKAA	Fadâr el Faouqa	فادار القوقا	1,050
Bekaa	WEST BEKAA	Fadâr el Tahia	فادار التاهيا	870
Bekaa	WEST BEKAA	Ghazze	غزة	870
Bekaa	WEST BEKAA	Hammarra	حمارة	870
Bekaa	WEST BEKAA	Hawch Aamiq	حوش اعقيق	870
Bekaa	WEST BEKAA	Hawch el Harime	حوش الحارمة	870
Bekaa	WEST BEKAA	Hawch El Sealtouk	حوش السعلوك	870
Bekaa	WEST BEKAA	Jabal Bir El Daher	جبل بئر الداهر	1,050
Bekaa	WEST BEKAA	Joub Jannine	جوت جنين	715
Bekaa	WEST BEKAA	Jwar Qourqoumaz	جوار قرقوماز	870
Bekaa	WEST BEKAA	Kafraya	كفريا	870
Bekaa	WEST BEKAA	Kamed el Laouz	كامل القوز	870
Bekaa	WEST BEKAA	Khiara	الخبارة	870
Bekaa	WEST BEKAA	Khribet Qanafar	خربة قنفار	870
Bekaa	WEST BEKAA	Lala	لالا	1,050
Bekaa	WEST BEKAA	Lubbaya	للبيا	1,050
Bekaa	WEST BEKAA	Loussia	لوسيا	870
Bekaa	WEST BEKAA	Machgara	مشغرة	1,440
Bekaa	WEST BEKAA	Mandara	المنارة	1,050
Bekaa	WEST BEKAA	Manoura	المنورة	620
Bekaa	WEST BEKAA	Mesidoun	ميدون	870
Bekaa	WEST BEKAA	Mrah El Bacha	مرح البشا	1,050
Bekaa	WEST BEKAA	Nabea El Khrizat	نابعا الخريزات	870
Bekaa	WEST BEKAA	Nabi Noun	نابي نون	870
Bekaa	WEST BEKAA	Nabi Zraiq	نابي زرايق	1,050
Bekaa	WEST BEKAA	Qararoun	القرون	560
Bekaa	WEST BEKAA	Qilya	قيا	870
Bekaa	WEST BEKAA	Sahrinj	سهرنج	870
Bekaa	WEST BEKAA	Saghbine	سغبين	1,050
Bekaa	WEST BEKAA	Sohmor	سحمر	870
Bekaa	WEST BEKAA	Souaini	السوايني	870
Bekaa	WEST BEKAA	Soultane Yaacoub el Faouqa	السولتان يعقوب القوقا	870
Bekaa	WEST BEKAA	Tall El Zaazaa	تل الزعازع	1,050
Bekaa	WEST BEKAA	Tall Znoub	تل زنوب	870
Bekaa	WEST BEKAA	Tall Znoub El Jdidéh	تل زنوب الجديدة	870
Bekaa	WEST BEKAA	Yohmor el Bekaa	يخمر	870
Bekaa	WEST BEKAA	Zellaya	زليا	870
Bekaa	ZAHLE	Aali en Nahri	عالي النهرى	690
Bekaa	ZAHLE	Anjar	انجر	690
Bekaa	ZAHLE	Ablah	ابلاخ	690
Bekaa	ZAHLE	Aln El Aasal	عن العسل	1,000
Bekaa	ZAHLE	Aln Kfar Zabad	عن كفر زباد	690
Bekaa	ZAHLE	Aln Jabbour	عن جبار	690
Bekaa	ZAHLE	Aln Jahaaf	عن جحاف	690
Bekaa	ZAHLE	Bar Elias	بار إلياس	690
Bekaa	ZAHLE	Beit Mbarak	بيت مبارك	690
Bekaa	ZAHLE	Bhana	بخنا	1,000
Bekaa	ZAHLE	Bouarej	بوارج	1,000
Bekaa	ZAHLE	Chaura	شوره	840
Bekaa	ZAHLE	Dahr Blit	دهر تليلد	690
Bekaa	ZAHLE	Dahr el Baydar	دهر البيدر	1,000

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Bekaa	ZAHLE	Saadnayeil	سعدنيل	690
Bekaa	ZAHLE	Sahem El Tawbeh	سهم التوبة	690
Bekaa	ZAHLE	Siret El Khnezir	سيرة الخنزير	690
Bekaa	ZAHLE	Taalaba	تالبا	690
Bekaa	ZAHLE	Taanayel	تانييل	690
Bekaa	ZAHLE	Tall Al Aamra	تل الامراء	690
Bekaa	ZAHLE	Tall el Akhdar	تل الاخضر	690
Bekaa	ZAHLE	Tall El Hijara	تل الحجر	690
Bekaa	ZAHLE	Tall El Sirhourm	تل السرحون	690
Bekaa	ZAHLE	Tallat Ayoub	تل ايوب	690
Bekaa	ZAHLE	Tarbil	تربيل	690
Bekaa	ZAHLE	Touaite	توية	690
Bekaa	ZAHLE	Zahle	زحلة	690
Bekaa	ZAHLE	Zeboul	زبول	690
Mount Lebanon	ALEY	Aabey	عبيه	960
Mount Lebanon	ALEY	Aarmousiyeh	عزموسية	850
Mount Lebanon	ALEY	Aaramoun	عراون	850
Mount Lebanon	ALEY	Aazouniyeh	عزونة	1185
Mount Lebanon	ALEY	Ain Anoub	عين انوب	850
Mount Lebanon	ALEY	Ain Dara	عين داره	1100
Mount Lebanon	ALEY	Ain Drail	عين دريل	850
Mount Lebanon	ALEY	Ain El Biyada	عين البيضة	1100
Mount Lebanon	ALEY	Ain El Jawrsh	عين الجوزة	945
Mount Lebanon	ALEY	Ain El Jolide	عين الجوليد	1065
Mount Lebanon	ALEY	Ain el Fraidis	عين الفريس	1100
Mount Lebanon	ALEY	Ain el Heltroun	عين الحلون	1000
Mount Lebanon	ALEY	Ain El Hawl	عين الحواز	1015
Mount Lebanon	ALEY	Ain El Lawrsh	عين اللوزة	1100
Mount Lebanon	ALEY	Ain El Marj	عين المارج	1100
Mount Lebanon	ALEY	Ain El Remmane	عين الرمان	1065
Mount Lebanon	ALEY	Ain El Saydeh	عين السيد	1000
Mount Lebanon	ALEY	Ain Hammama	عين حممة	1010
Mount Lebanon	ALEY	Ain Hjay	عين حجابي	870
Mount Lebanon	ALEY	Ain Joualq	عين جولاق	922
Mount Lebanon	ALEY	Ain Ksour	عين كسور	955
Mount Lebanon	ALEY	Ain Miriel	عين مريمي	900
Mount Lebanon	ALEY	Ain Tret	عين ترات	925
Mount Lebanon	ALEY	Ainab	عيناب	965
Mount Lebanon	ALEY	Alsat	السات	915
Mount Lebanon	ALEY	Aley	عاليه	1050
Mount Lebanon	ALEY	Baaouerta	بعاورته	870
Mount Lebanon	ALEY	Blissour	بليصور	975
Mount Lebanon	ALEY	Bcharoun	بشارون	850
Mount Lebanon	ALEY	Bedoun	بداون	880
Mount Lebanon	ALEY	Beughane	بوغان	1100
Mount Lebanon	ALEY	Bhamdoun	بحدون الصبية	1170
Mount Lebanon	ALEY	Bhamdoun El Dayaa	بحدون الصبية	1175
Mount Lebanon	ALEY	Bhouara	بجورة	935
Mount Lebanon	ALEY	Bilhat	بيلحات	850
Mount Lebanon	ALEY	Bkhechay	بختة	1050
Mount Lebanon	ALEY	Blaibel	بلايل	850
Mount Lebanon	ALEY	Bimahray	بمهرية	1100
Mount Lebanon	ALEY	Bmekkine	بمكين	950
Mount Lebanon	ALEY	Brihaye	البريه	985
Mount Lebanon	ALEY	Bou Zraide	بور زرايد	850
Mount Lebanon	ALEY	Boufin	بوفين	850
Mount Lebanon	ALEY	Bsermine	بسرين	1025
Mount Lebanon	ALEY	Bsounay	بسنايه	1175
Mount Lebanon	ALEY	Bsout	بسوت	850
Mount Lebanon	ALEY	Btaloun	بطلون	1165
Mount Lebanon	ALEY	Btater	بتاتر	1125
Mount Lebanon	ALEY	Bwar El Din	بوار الدين	850
Mount Lebanon	ALEY	Chammis	شميس	900
Mount Lebanon	ALEY	Chanay	شايه	1150
Mount Lebanon	ALEY	Charoun	شارون	1140
Mount Lebanon	ALEY	Chartoun	شارتون	850
Mount Lebanon	ALEY	Chatra	شتره	975
Mount Lebanon	ALEY	Chawyet Ain El Krayem	شويته عين الكريم	1050
Mount Lebanon	ALEY	Chemilane	شملان	900
Mount Lebanon	ALEY	Choufete	شوفيتات	850
Mount Lebanon	ALEY	Daher Ain El Hajal	داهر عين الحجل	1100
Mount Lebanon	ALEY	Daher El Wahch	داهر الوحش	850
Mount Lebanon	ALEY	Daqqoun	داقون	862
Mount Lebanon	ALEY	Dawheth Aaramoun	دوحة عراون	850
Mount Lebanon	ALEY	Deir Mar Youhanna (Rechmaya)	دير مار يوحنا	925
Mount Lebanon	ALEY	Deir Saydet El Maouna (Aabay)	دير سيدة المونان (عيا)	975
Mount Lebanon	ALEY	Deir Saydet El Maounat (Chimlan)	دير سيدة المونان (شيملان)	900
Mount Lebanon	ALEY	Deir Sir (Deir Mar Antonios)	دير سير (دير مار انتونوس)	1057
Mount Lebanon	ALEY	Deir Qoubil	دير قوبيل	850
Mount Lebanon	ALEY	Dfoun	دفون	940
Mount Lebanon	ALEY	Dhour el Aabediye	دوير العابدية	1120
Mount Lebanon	ALEY	Doueit er Remmane	دويتير رمان	925
Mount Lebanon	ALEY	El Adaiseh	العديسه	1100
Mount Lebanon	ALEY	El Blala	البلالة	850
Mount Lebanon	ALEY	El Bsatine	البيصين	900
Mount Lebanon	ALEY	El Bwait	البيوت	850
Mount Lebanon	ALEY	El Dqarine	الداقارين	975
Mount Lebanon	ALEY	El Kharab	الخراب	1050
Mount Lebanon	ALEY	El Khrabiz	الخرابية	900
Mount Lebanon	ALEY	El Maaysir	المعصر	1175
Mount Lebanon	ALEY	El Machrah	المشراح	1050
Mount Lebanon	ALEY	El Mensoura	المسورة	882
Mount Lebanon	ALEY	El Marj	المرج	935
Mount Lebanon	ALEY	El Nasraniye	النصرانية	850
Mount Lebanon	ALEY	El Qalaa	القلعة	862
Mount Lebanon	ALEY	El Rwaissat	الروايسات	850
Mount Lebanon	ALEY	El Wata	الواطي	1085
Mount Lebanon	ALEY	Flajjine	فلجين	1000
Mount Lebanon	ALEY	Fraqine	فراقين	880
Mount Lebanon	ALEY	Ghaboun	غبون	950
Mount Lebanon	ALEY	Habramoun	حبرامون	900
Mount Lebanon	ALEY	Hanan	حنان	1090
Mount Lebanon	ALEY	Haret el Mir	حارة المير	925
Mount Lebanon	ALEY	Haret Salem	حارة سالم	850
Mount Lebanon	ALEY	Harit Hamzeh	حارة حمزة	875
Mount Lebanon	ALEY	Homsat Hama	حما	920
Mount Lebanon	ALEY	Houmal	حومال	850
Mount Lebanon	ALEY	Ighmid	اغميد	1160
Mount Lebanon	ALEY	Jal El Baher	جل البهر	850
Mount Lebanon	ALEY	Jisr el Qadi	جسر القاضي	850
Mount Lebanon	ALEY	Jourit El Ballout	جوزة الطوط	850
Mount Lebanon	ALEY	Kahale	الكهله	875
Mount Lebanon	ALEY	Kaifoun	كيفون	1000

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Bekaa	ZAHLE	Saadnayeil	سعدنيل	690
Bekaa	ZAHLE	Sahem El Tawbeh	سهم التوبة	690
Bekaa	ZAHLE	Siret El Khnezir	سيرة الخنزير	690
Bekaa	ZAHLE	Taalaba	تالبا	690
Bekaa	ZAHLE	Taanayel	تانييل	690
Bekaa	ZAHLE	Tall Al Aamra	تل الامراء	690
Bekaa	ZAHLE	Tall el Akhdar	تل الاخضر	690
Bekaa	ZAHLE	Tall El Hijara	تل الحجر	690
Bekaa	ZAHLE	Tall El Sirhourm	تل السرحون	690
Bekaa	ZAHLE	Tallat Ayoub	تل ايوب	690
Bekaa	ZAHLE	Tarbil	تربيل	690
Bekaa	ZAHLE	Touaite	توية	690
Bekaa	ZAHLE	Zahle	زحلة	690
Bekaa	ZAHLE	Zeboul	زبول	690
Mount Lebanon	ALEY	Aabey	عبيه	960
Mount Lebanon	ALEY	Aarmousiyeh	عزموسية	850
Mount Lebanon	ALEY	Aaramoun	عراون	850
Mount Lebanon	ALEY	Aazouniyeh	عزونة	1185
Mount Lebanon	ALEY	Ain Anoub	عين انوب	850
Mount Lebanon	ALEY	Ain Dara	عين داره	1100
Mount Lebanon	ALEY	Ain Drail	عين دريل	850
Mount Lebanon	ALEY	Ain El Biyada	عين البيضة	1100
Mount Lebanon	ALEY	Ain El Jawrsh	عين الجوزة	945
Mount Lebanon	ALEY	Ain El Jolide	عين الجوليد	1065
Mount Lebanon	ALEY	Ain el Fraidis	عين الفريس	1100
Mount Lebanon	ALEY	Ain el Heltroun	عين الحلون	1000
Mount Lebanon	ALEY	Ain El Hawl	عين الحواز	1015
Mount Lebanon	ALEY	Ain El Lawrsh	عين اللوزة	1100
Mount Lebanon	ALEY	Ain El Marj	عين المارج	1100
Mount Lebanon	ALEY	Ain El Remmane	عين الرمان	1065
Mount Lebanon	ALEY	Ain El Saydeh	عين السيد	1000
Mount Lebanon	ALEY	Ain Hammama	عين حممة	1010
Mount Lebanon	ALEY	Ain Hjay	عين حجابي	870
Mount Lebanon	ALEY	Ain Joualq	عين جولاق	922
Mount Lebanon	ALEY	Ain Ksour	عين كسور	955
Mount Lebanon	ALEY	Ain Miriel	عين مريمي	900
Mount Lebanon	ALEY	Ain Tret	عين ترات	925
Mount Lebanon	ALEY	Ainab	عيناب	965
Mount Lebanon	ALEY	Alsat	السات	915
Mount Lebanon	ALEY	Aley	عاليه	1050
Mount Lebanon	ALEY	Baaouerta	بعاورته	870
Mount Lebanon	ALEY	Blissour	بليصور	975
Mount Lebanon	ALEY	Bcharoun	بشارون	850
Mount Lebanon	ALEY	Bedoun	بداون	880
Mount Lebanon	ALEY	Beughane	بوغان	1100
Mount Lebanon	ALEY	Bhamdoun	بحدون الصبية	1170
Mount Lebanon	ALEY	Bhamdoun El Dayaa	بحدون الصبية	1175
Mount Lebanon	ALEY	Bhouara	بجورة	935
Mount Lebanon	ALEY	Bilhat	بيلحات	850
Mount Lebanon	ALEY	Bkhechay	بختة	1050
Mount Lebanon	ALEY	Blaibel	بلايل	850
Mount Lebanon	ALEY	Bimahray	بمهرية	1100
Mount Lebanon	ALEY	Bmekkine	بمكين	950
Mount Lebanon	ALEY	Brihaye	البريه	985
Mount Lebanon	ALEY	Bou Zraide	بور زرايد	850
Mount Lebanon	ALEY	Boufin	بوفين	850



RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	ALEY	Khaldeh	خده	850
Mount Lebanon	ALEY	Khalwat Rwaiss	خوات رويسية	850
Mount Lebanon	ALEY	Khalwat Aainab	خوة عيناب	1025
Mount Lebanon	ALEY	Khalwet El Mounsefseh	خوة النوسفة	905
Mount Lebanon	ALEY	Kfar Aameily	كفر اعلمية	1050
Mount Lebanon	ALEY	Kfar Matza	كفر مطز	1045
Mount Lebanon	ALEY	Kjailye	كجيلة	850
Mount Lebanon	ALEY	Maalacoun	معلعون	950
Mount Lebanon	ALEY	Maaraiti	معاريتي	850
Mount Lebanon	ALEY	Marchoti	مشتحي	1100
Mount Lebanon	ALEY	Majdalaya	مجدلأيا	850
Mount Lebanon	ALEY	Majdel Baana	مجدل بنا	1125
Mount Lebanon	ALEY	Mansouriyeh	منصورية	1145
Mount Lebanon	ALEY	Mar Elias	مار الياس	850
Mount Lebanon	ALEY	Matar	مطار	850
Mount Lebanon	ALEY	Mazraat en Nahir	مزرعة النهر	865
Mount Lebanon	ALEY	Mdairé	المديرج	1100
Mount Lebanon	ALEY	Mechrefe	المشرفة	1085
Mount Lebanon	ALEY	Majdel Baana	مجدلأيا	1130
Mount Lebanon	ALEY	Mhallet Bhamdoun	محدون المحمه	1125
Mount Lebanon	ALEY	Midan El Zir	ميدان الزير	850
Mount Lebanon	ALEY	Mighwaya	مغويا	975
Mount Lebanon	ALEY	Mreijat	مريجات	1110
Mount Lebanon	ALEY	Nabaa es Safa	نابع الصفا	850
Mount Lebanon	ALEY	Nabaa Majed	نابع ماجد	1100
Mount Lebanon	ALEY	Qabr Chamoun	قبر شامون	975
Mount Lebanon	ALEY	Omatiyeh	الوماتية	900
Mount Lebanon	ALEY	Qoubrous	قوبروس	850
Mount Lebanon	ALEY	Ramliye	رملية	875
Mount Lebanon	ALEY	Ramtoun	رمتون	1025
Mount Lebanon	ALEY	Ras Aairam	راس اعزام	1050
Mount Lebanon	ALEY	Ras El Aaqabeh	راس العقاب	850
Mount Lebanon	ALEY	Ras Mena	راس منا	850
Mount Lebanon	ALEY	Rechmaiya	رشمايا	915
Mount Lebanon	ALEY	Rejme	الرجمة	1000
Mount Lebanon	ALEY	Remhalla	رشملا	850
Mount Lebanon	ALEY	Rjoum	رجوم	885
Mount Lebanon	ALEY	Rmaile	رملية	920
Mount Lebanon	ALEY	Rouissat Sofar	رويسات صوفر	1195
Mount Lebanon	ALEY	Rouisset en Naamane	رويسات النعام	1119
Mount Lebanon	ALEY	Rwaissat Abd El Malek	رويسات عبد الملك	850
Mount Lebanon	ALEY	Saraimoul	سرايمول	850
Mount Lebanon	ALEY	Sibal	سبل	1110
Mount Lebanon	ALEY	Siffaya	سفييا	850
Mount Lebanon	ALEY	Sofar	صوفر	1100
Mount Lebanon	ALEY	Souq el Gharb	سوق الغرب	980
Mount Lebanon	ALEY	Tazmiye	تازمية	1050
Mount Lebanon	ALEY	Tardala	تاردا	925
Mount Lebanon	ALEY	Twaiteh	تويتة	1100
Mount Lebanon	ALEY	Wadi Bidghan	وادي بدغان	1050
Mount Lebanon	ALEY	Wata Charone	وطني شاون	1075
Mount Lebanon	BAABDA	Aabadiye	الاعبية	990
Mount Lebanon	BAABDA	Aarbaniye	العربانية	920
Mount Lebanon	BAABDA	Aarsouriye	الاعسورية	850
Mount Lebanon	BAABDA	Ain Abou Qaimeh	عين ابو قايمة	1105
Mount Lebanon	BAABDA	Ain Bilt	عين بيت	1100

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	BAABDA	Ain El Dailbeh	عين الديلة	860
Mount Lebanon	BAABDA	Ain El Sohab	عين السهبة	1100
Mount Lebanon	BAABDA	Ain er Roummame	عين الرومة	850
Mount Lebanon	BAABDA	Ain Hamadeh	عين حماد	930
Mount Lebanon	BAABDA	Ain Mouaffaq	عين موافق	965
Mount Lebanon	BAABDA	Arayla	ارايلا	860
Mount Lebanon	BAABDA	Arsoun	ارصون	990
Mount Lebanon	BAABDA	Baaba	بنا	850
Mount Lebanon	BAABDA	Baalchemay	بعلشميه	1125
Mount Lebanon	BAABDA	Bhala	بذلا	1175
Mount Lebanon	BAABDA	Bir Hassam	بصر حسن	850
Mount Lebanon	BAABDA	Bmaimam	بمائم	1015
Mount Lebanon	BAABDA	Bogle	بقة	912
Mount Lebanon	BAABDA	Bonj el Brajine	بوج البراجية	850
Mount Lebanon	BAABDA	Bouchal	بوشال	850
Mount Lebanon	BAABDA	Bsaba	بسبا	850
Mount Lebanon	BAABDA	Bzailine	بضلين	1050
Mount Lebanon	BAABDA	Btebyat	بتيبات	980
Mount Lebanon	BAABDA	Btekhny	بتيخيه	1100
Mount Lebanon	BAABDA	Bzebline	بزلين	1060
Mount Lebanon	BAABDA	Chamish	الشامية	875
Mount Lebanon	BAABDA	Chayyah	الشايحة	1030
Mount Lebanon	BAABDA	Chouit	شويت	925
Mount Lebanon	BAABDA	Dahr el Baydar	داه صبا	895
Mount Lebanon	BAABDA	Daichouniye	داحونيه	1100
Mount Lebanon	BAABDA	Deir el Harf	دير الحرف	1120
Mount Lebanon	BAABDA	Deir El Qaraqfeh	دير القرقبة	850
Mount Lebanon	BAABDA	Deir Khouna	دير خونا	875
Mount Lebanon	BAABDA	Deir Mar Afram El Raghm	دير مار افرام الرعم	987
Mount Lebanon	BAABDA	Deir Mar Elias - El Kahlouniye	دير مار الياس الكهلونية	1005
Mount Lebanon	BAABDA	Deir Mar Youhanna-Qobbai	دير مار يوحنا القوبي	900
Mount Lebanon	BAABDA	Diabe	الديبة	900
Mount Lebanon	BAABDA	Faiyadiye	فايادية	850
Mount Lebanon	BAABDA	Falougha	فالوطا	1100
Mount Lebanon	BAABDA	Form El Chebak	فورن الشيبك	850
Mount Lebanon	BAABDA	Ghabet El Chamiyeh	غابة الشامية	1125
Mount Lebanon	BAABDA	Ghbair	الغبيري	850
Mount Lebanon	BAABDA	Haqel Hassan	هقل حسن	900
Mount Lebanon	BAABDA	Hazel Safi	هقل صافي	1100
Mount Lebanon	BAABDA	Hadet	الحدت	850
Mount Lebanon	BAABDA	Hamama	حمقا	1150
Mount Lebanon	BAABDA	Haret el Botom	حارة البتوم	850
Mount Lebanon	BAABDA	Haret El Tahta	حارة التحا	1100
Mount Lebanon	BAABDA	Haret es Saft	حارة السفت	850
Mount Lebanon	BAABDA	Haret Hamze	حارة حمزة	920
Mount Lebanon	BAABDA	Haret Hrak	حارة حريك	850
Mount Lebanon	BAABDA	Hasbaniye el Mein	حاصبيا العين	975
Mount Lebanon	BAABDA	Hay El Byader	حي البيار	1100
Mount Lebanon	BAABDA	Hazmiye	الهازمية	850
Mount Lebanon	BAABDA	Hlaliye	الهلالية	875
Mount Lebanon	BAABDA	Jabal El Knayseh	جبل الكنبية	1100
Mount Lebanon	BAABDA	Jamhour	الجهور	850
Mount Lebanon	BAABDA	Jour el Houz	جور الحوز	1100
Mount Lebanon	BAABDA	Jourat Arsoum	جورات ارصون	1065
Mount Lebanon	BAABDA	Jouret El Darb	جورة الدرب	1100



RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	BAABDA	Kahlouyeh	كحلوية	1005
Mount Lebanon	BAABDA	Kfar Selouane	كفر سلوان	1100
Mount Lebanon	BAABDA	Kfar Shima	كفر شيماء	850
Mount Lebanon	BAABDA	Khalloubye	خلوبية	1020
Mount Lebanon	BAABDA	Khalwat	الخرات	925
Mount Lebanon	BAABDA	Khalwat Falougha	خرات فالوغا	1150
Mount Lebanon	BAABDA	Khrabe	الخرابية	1055
Mount Lebanon	BAABDA	Krissse	الكريسة	925
Mount Lebanon	BAABDA	Lalake	اللابة	850
Mount Lebanon	BAABDA	Louaize	لوايزة	1005
Mount Lebanon	BAABDA	Maadon	معدان	950
Mount Lebanon	BAABDA	Maadon	معدان	1005
Mount Lebanon	BAABDA	Mar Taqla	مار تقلا	850
Mount Lebanon	BAABDA	Mazraat Ayoub	مزرعة ايوب	850
Mount Lebanon	BAABDA	Mazraat El Maaystrah	مزرعة المصطرة	935
Mount Lebanon	BAABDA	Merbache	المرباحية	850
Mount Lebanon	BAABDA	Mghaltheh	مغنية	1100
Mount Lebanon	BAABDA	Mhata	المهتة	850
Mount Lebanon	BAABDA	Mouwasi	مواصي	950
Mount Lebanon	BAABDA	Mraijje	المريجة	850
Mount Lebanon	BAABDA	Nabea El Chaghour	نابعا للشارع	1100
Mount Lebanon	BAABDA	Ouadi Chahrour	وادي شحور	850
Mount Lebanon	BAABDA	Ouadi Dib	وادي الديب	850
Mount Lebanon	BAABDA	Ouzai	الاوزاعي	850
Mount Lebanon	BAABDA	Qalaa	القلعة	1125
Mount Lebanon	BAABDA	Qanater Zboydeh	قناطر زبيدة	850
Mount Lebanon	BAABDA	Qirtada	قرطاسية	900
Mount Lebanon	BAABDA	Qomayel	قومايل	1180
Mount Lebanon	BAABDA	Qoubbeiaa	قوبع	1090
Mount Lebanon	BAABDA	Qraijje	القرائية	1100
Mount Lebanon	BAABDA	Qsailbe	القسايبية	890
Mount Lebanon	BAABDA	Qrale	قراة	895
Mount Lebanon	BAABDA	Ras el Harf	راس الحرف	1000
Mount Lebanon	BAABDA	Ras el Mein	راس المن	1070
Mount Lebanon	BAABDA	Roussset el Bailout	روسيه الطوط	985
Mount Lebanon	BAABDA	Rwaysat El Marj	رويسات المراج	1085
Mount Lebanon	BAABDA	Rwaysat Qobbai	رويسات قوبع	1100
Mount Lebanon	BAABDA	Rwaysat Salima	رويسات صليما	1017
Mount Lebanon	BAABDA	Salima	صليما	1005
Mount Lebanon	BAABDA	Sbnay	سبنية	850
Mount Lebanon	BAABDA	Tahouiet el Ghadir	تحويت الغدير	850
Mount Lebanon	BAABDA	Tahouiet en Naher	تحويت النهر	850
Mount Lebanon	BAABDA	Talitia	تاليتا	900
Mount Lebanon	BAABDA	Tarchich	تارحيش	1100
Mount Lebanon	BAABDA	Tayouneh	التيونيه	850
Mount Lebanon	BAABDA	Yarzeh	اليارزة	850
Mount Lebanon	BAABDA	Zandouqa	زاندوقة	875
Mount Lebanon	BAABDA	Zhalmeih	الزحمية	850
Mount Lebanon	BAABDA	Zire	الزيرة	850
Mount Lebanon	CHOUF	Aammattour	عالمطور	1110
Mount Lebanon	CHOUF	Aammiq	عاقيق	865
Mount Lebanon	CHOUF	Aamout	عاقوت	970
Mount Lebanon	CHOUF	Asqalayn	عاقلين	850
Mount Lebanon	CHOUF	Asrime	عسرين	990
Mount Lebanon	CHOUF	Ain Bal	عين بال	1030
Mount Lebanon	CHOUF	Ain Bou Khattar	عين بو خطار	900
Mount Lebanon	CHOUF	Ain El Assad	عين الاسد	850
Mount Lebanon	CHOUF	Ain el Haour	عين الحور	915
Mount Lebanon	CHOUF	Ain El Saadeh	عين السادة	850
Mount Lebanon	CHOUF	Ain Ghazi	عين غازي	900
Mount Lebanon	CHOUF	Ain Qeni	عين قني	1015
Mount Lebanon	CHOUF	Ain Wouazin	عين ووزان	1100
Mount Lebanon	CHOUF	Ain Zhalta	عين زحلثا	1145
Mount Lebanon	CHOUF	Arez Ain Zhalta	ارز عين زحلثا	1100
Mount Lebanon	CHOUF	Arez El Barouq	ارز الباروك	1100
Mount Lebanon	CHOUF	Arez Maaser El Chouf	ارز معاصر الشوف	1100
Mount Lebanon	CHOUF	Almane ed Dalaa	المان	850
Mount Lebanon	CHOUF	Baadrazne	بخران	1125
Mount Lebanon	CHOUF	Baal en Naame	بال ناعمة	850
Mount Lebanon	CHOUF	Baalqine	بعلقين	1030
Mount Lebanon	CHOUF	Baasir	بعاسير	850
Mount Lebanon	CHOUF	Baidar El Mir	بيدر المير	850
Mount Lebanon	CHOUF	Baidar El Rameil	بيدر الرامل	850
Mount Lebanon	CHOUF	Balqoun	بالقون	1030
Mount Lebanon	CHOUF	Beqoun et Bakhaoun	بقفون	850
Mount Lebanon	CHOUF	Barja	برجا	850
Mount Lebanon	CHOUF	Barouk	الباروك	1155
Mount Lebanon	CHOUF	Bater	باتر	1010
Mount Lebanon	CHOUF	Battoun	ببتون	1140
Mount Lebanon	CHOUF	Battal	بتال	850
Mount Lebanon	CHOUF	Bchalfine	بشلفين	850
Mount Lebanon	CHOUF	Beit ed Dine	بيت الدين	1030
Mount Lebanon	CHOUF	Benoel	بنوئي	850
Mount Lebanon	CHOUF	Blire	البيرة	1060
Mount Lebanon	CHOUF	Blqaiza	بلقا	1025
Mount Lebanon	CHOUF	Bkecthine	بكتشين	915
Mount Lebanon	CHOUF	Bkifa	بكيبا	880
Mount Lebanon	CHOUF	Bkirzay	بكرزيه	900
Mount Lebanon	CHOUF	Bnenwe	بننوه	850
Mount Lebanon	CHOUF	Boqseh	بوقسه	850
Mount Lebanon	CHOUF	Borjein	البرجين	850
Mount Lebanon	CHOUF	Boutme	بوتمة	1060
Mount Lebanon	CHOUF	Brith	بريث	1000
Mount Lebanon	CHOUF	Bsaba	بسابا	1025
Mount Lebanon	CHOUF	Bsonay	بسمانية	1000
Mount Lebanon	CHOUF	Cheikh Mohammad Al Dimas	الشيخ محمد الديراس	850
Mount Lebanon	CHOUF	Chhime	شخيم	880
Mount Lebanon	CHOUF	Chmaarine	شمارين	850
Mount Lebanon	CHOUF	Chmis	الشميم	850
Mount Lebanon	CHOUF	Chouit	شويت	850
Mount Lebanon	CHOUF	Chouit	شويريت	915
Mount Lebanon	CHOUF	Dabbeh	دببة	975
Mount Lebanon	CHOUF	Daheer Asqalayn	صهبر عاقلين	850
Mount Lebanon	CHOUF	Daher El Jabal	صهبر الجبل	850
Mount Lebanon	CHOUF	Dahr el Mghara	صهبر المغارة	850
Mount Lebanon	CHOUF	Dalhmye	دالهمية	850
Mount Lebanon	CHOUF	Dalhoun	دالھون	850
Mount Lebanon	CHOUF	Damour	الدامور	850
Mount Lebanon	CHOUF	Daraliya	داراليا	850
Mount Lebanon	CHOUF	Daraliya	داراليا	970
Mount Lebanon	CHOUF	Deir Baba	دير بابا	850
Mount Lebanon	CHOUF	Deir Dourit	دير دوريت	900
Mount Lebanon	CHOUF	Deir El Mkhales	دير المخلص	850

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	BAABDA	Kahlouyeh	كحلوية	1005
Mount Lebanon	BAABDA	Kfar Selouane	كفر سلوان	1100
Mount Lebanon	BAABDA	Kfar Shima	كفر شيماء	850
Mount Lebanon	BAABDA	Khalloubye	خلوبية	1020
Mount Lebanon	BAABDA	Khalwat	الخرات	925
Mount Lebanon	BAABDA	Khalwat Falougha	خرات فالوغا	1150
Mount Lebanon	BAABDA	Khrabe	الخرابية	1055
Mount Lebanon	BAABDA	Krissse	الكريسة	925
Mount Lebanon	BAABDA	Lalake	اللابة	850
Mount Lebanon	BAABDA	Louaize	لوايزة	1005
Mount Lebanon	BAABDA	Maadon	معدان	950
Mount Lebanon	BAABDA	Maadon	معدان	1005
Mount Lebanon	BAABDA	Mar Taqla	مار تقلا	850
Mount Lebanon	BAABDA	Mazraat Ayoub	مزرعة ايوب	850
Mount Lebanon	BAABDA	Mazraat El Maaystrah	مزرعة المصطرة	935
Mount Lebanon	BAABDA	Merbache	المرباحية	850
Mount Lebanon	BAABDA	Mghaltheh	مغنية	1100
Mount Lebanon	BAABDA	Mhata	المهتة	850
Mount Lebanon	BAABDA	Mouwasi	مواصي	950
Mount Lebanon	BAABDA	Mraijje	المريجة	850
Mount Lebanon	BAABDA	Nabea El Chaghour	نابعا للشارع	1100
Mount Lebanon	BAABDA	Ouadi Chahrour	وادي شحور	850
Mount Lebanon	BAABDA	Ouadi Dib	وادي الديب	850
Mount Lebanon	BAABDA	Ouzai	الاوزاعي	850
Mount Lebanon	BAABDA	Qalaa	القلعة	1125
Mount Lebanon	BAABDA	Qanater Zboydeh	قناطر زبيدة	850
Mount Lebanon	BAABDA	Qirtada	قرطاسية	900
Mount Lebanon	BAABDA	Qomayel	قومايل	1180
Mount Lebanon	BAABDA	Qoubbeiaa	قوبع	1090
Mount Lebanon	BAABDA	Qraijje	القرائية	1100
Mount Lebanon	BAABDA	Qsailbe	القسايبية	890
Mount Lebanon	BAABDA	Qrale	قراة	895
Mount Lebanon	BAABDA	Ras el Harf	راس الحرف	1000
Mount Lebanon	BAABDA	Ras el Mein	راس المن	1070
Mount Lebanon	BAABDA	Roussset el Bailout	روسيه الطوط	985
Mount Lebanon	BAABDA	Rwaysat El Marj	رويسات المراج	1085
Mount Lebanon	BAABDA	Rwaysat Qobbai	رويسات قوبع	1100
Mount Lebanon	BAABDA	Rwaysat Salima	رويسات صليما	1017
Mount Lebanon	BAABDA	Salima	صليما	1005
Mount Lebanon	BAABDA	Sbnay	سبنية	850
Mount Lebanon	BAABDA	Tahouiet el Ghadir	تحويت الغدير	850
Mount Lebanon	BAABDA	Tahouiet en Naher	تحويت النهر	850
Mount Lebanon	BAABDA	Talitia	تاليتا	900
Mount Lebanon	BAABDA	Tarchich	تارحيش	1100
Mount Lebanon	BAABDA	Tayouneh	التيونيه	850
Mount Lebanon	BAABDA	Yarzeh	اليارزة	850
Mount Lebanon	BAABDA	Zandouqa	زاندوقة	875
Mount Lebanon	BAABDA	Zhalmeih	الزحمية	850
Mount Lebanon	BAABDA	Zire	الزيرة	850
Mount Lebanon	CHOUF	Aammattour	عالمطور	1110
Mount Lebanon	CHOUF	Aammiq	عاقيق	865
Mount Lebanon	CHOUF	Aamout	عاقوت	970
Mount Lebanon	CHOUF	Asqalayn	عاقلين	850
Mount Lebanon	CHOUF	Asrime	عسرين	990
Mount Lebanon	CHOUF	Ain Bal	عين بال	1030
Mount Lebanon	CHOUF	Ain Bou Khattar	عين بو خطار	900



RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	CHOUF	Deir el Qamar	دير القمر	995
Mount Lebanon	CHOUF	Deir El Rahbat	دير الرهاط	850
Mount Lebanon	CHOUF	Deir El Saydeh	دير السيدة	850
Mount Lebanon	CHOUF	Deir Koucheh	دير كوشة	850
Mount Lebanon	CHOUF	Deir Mir Aabda ( Deir El Qamar)	دير مار عبدا (دير القمر)	1099
Mount Lebanon	CHOUF	Deir Mar Jerjes ( El Ne'meh)	دير مار جرجس (النعمة)	850
Mount Lebanon	CHOUF	Deir Mar Maroun (Ber Snain)	دير مار مارون (بر سنين)	945
Mount Lebanon	CHOUF	Dibbiye	الديبية	850
Mount Lebanon	CHOUF	Dmit	دميت	850
Mount Lebanon	CHOUF	El Aatiga	العينة	850
Mount Lebanon	CHOUF	El Barchojeh	البارحوجة	850
Mount Lebanon	CHOUF	El Battal	البتال	850
Mount Lebanon	CHOUF	El Bissayn	البصيل	1025
Mount Lebanon	CHOUF	El Bivatdeh	البيضة	1050
Mount Lebanon	CHOUF	El Bqayaa	البقعة	850
Mount Lebanon	CHOUF	El Charbine	الشربين	940
Mount Lebanon	CHOUF	El Chwalliq	الخرابيق	865
Mount Lebanon	CHOUF	El Dahr	الدهر	935
Mount Lebanon	CHOUF	El Dweir	الدوير	850
Mount Lebanon	CHOUF	El Farbat	الفرط	850
Mount Lebanon	CHOUF	El Fatba	الفاطة	850
Mount Lebanon	CHOUF	El Fawara	الغورا	935
Mount Lebanon	CHOUF	El Fiqaniyeh	الفيقانية	850
Mount Lebanon	CHOUF	El Fkhayteh	الفخية	850
Mount Lebanon	CHOUF	El Foukhaara	الفخارة	975
Mount Lebanon	CHOUF	El Hara	الحارة	850
Mount Lebanon	CHOUF	El Hardouch	الحدوش	850
Mount Lebanon	CHOUF	El Hsara	الحسرة	975
Mount Lebanon	CHOUF	El Hsikan	الحيكان	850
Mount Lebanon	CHOUF	El Hijlijeh	الحجاجية	880
Mount Lebanon	CHOUF	El Jaayil	الجاييل	1130
Mount Lebanon	CHOUF	El Jind	الجند	1000
Mount Lebanon	CHOUF	El Khandiq	الخانق	850
Mount Lebanon	CHOUF	El Marj	المرج	850
Mount Lebanon	CHOUF	El Meqrana	المقرنة	850
Mount Lebanon	CHOUF	El Mermata	الممرطة	850
Mount Lebanon	CHOUF	El Mghayeh	المغرة	850
Mount Lebanon	CHOUF	El Mourameh	المورمة	850
Mount Lebanon	CHOUF	El Mizayyat	الميزيات	850
Mount Lebanon	CHOUF	El Mtolleh	المثلة	1000
Mount Lebanon	CHOUF	El Nabi Ayoub	النبي ايوب	985
Mount Lebanon	CHOUF	El Nabi Youniss	النبي يونس	850
Mount Lebanon	CHOUF	El Qachya	القاشية	1050
Mount Lebanon	CHOUF	El Qate'	القطة	850
Mount Lebanon	CHOUF	El Qate'	القطة	850
Mount Lebanon	CHOUF	El Qrayaa	القرعة	875
Mount Lebanon	CHOUF	El Qrayeh	القرية	1025
Mount Lebanon	CHOUF	El Rimameh	الريممة	850
Mount Lebanon	CHOUF	E Rizenyeh	الرزنية	850
Mount Lebanon	CHOUF	El Rkham	الركم	850
Mount Lebanon	CHOUF	El Sarouniye	السرغونية	850
Mount Lebanon	CHOUF	El Shtyar	الشيار	850
Mount Lebanon	CHOUF	El Zaanour	الزعرور	850
Mount Lebanon	CHOUF	El Zentounyeh	الزنتونية	912
Mount Lebanon	CHOUF	Fraïdis	الفرديس	1150
Mount Lebanon	CHOUF	Ghabt Jaifar	غابة جعفر	915

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	CHOUF	Gharife	غريبة	940
Mount Lebanon	CHOUF	Hbaichiyeh	حبايحية	850
Mount Lebanon	CHOUF	Hajrouneh	هجرنة	850
Mount Lebanon	CHOUF	Harret Baasir	حارة باعسر	850
Mount Lebanon	CHOUF	Harret El Aaqbe	حارة العقبة	850
Mount Lebanon	CHOUF	Harret El Naime	حارة النعمة	850
Mount Lebanon	CHOUF	Harret Jandal	حارة جندل	1000
Mount Lebanon	CHOUF	Hasroun	حسرون	980
Mount Lebanon	CHOUF	Iskandarouna	اسكندرونة	850
Mount Lebanon	CHOUF	Jabal El Barrouq	جبل الباروق	1100
Mount Lebanon	CHOUF	Jadra	جذرا	850
Mount Lebanon	CHOUF	Jahliye	الجاهلية	850
Mount Lebanon	CHOUF	Jamaliye	الجمالية	850
Mount Lebanon	CHOUF	Jbaa	جباة	1165
Mount Lebanon	CHOUF	Jdaide	الجديدة	1000
Mount Lebanon	CHOUF	Jilblay	جبلية	1050
Mount Lebanon	CHOUF	Jiyé	الجيبة	850
Mount Lebanon	CHOUF	Jlailiye	الجلايلية	935
Mount Lebanon	CHOUF	Job Ghebra	جوب غبرة	850
Mount Lebanon	CHOUF	Joun	جون	850
Mount Lebanon	CHOUF	Kal'ouniye	الكاونية	1020
Mount Lebanon	CHOUF	Karziya	كارزيا	850
Mount Lebanon	CHOUF	Kfar Faquod	كفر فاقد	855
Mount Lebanon	CHOUF	Kfar Hamal	كفر حمل	975
Mount Lebanon	CHOUF	Kfar Hay	كفر هي	855
Mount Lebanon	CHOUF	Kfar Him	كفر هم	900
Mount Lebanon	CHOUF	Kfar Nabrahk	كفر نابرخ	1105
Mount Lebanon	CHOUF	Kfar Miss	كفر ميس	1065
Mount Lebanon	CHOUF	Kfar Qatra	كفر قطرة	980
Mount Lebanon	CHOUF	Khalwat Bou Ezz El Din	خوات بو عزالدين	950
Mount Lebanon	CHOUF	Khalwat Jimaya	خوات جيمية	975
Mount Lebanon	CHOUF	Khalwet el Katalieb	خوات كاتاليب	1035
Mount Lebanon	CHOUF	Khibit Bisri	خربة بسري	850
Mount Lebanon	CHOUF	Khralbe	الخرية	1120
Mount Lebanon	CHOUF	Klayil	كليل	850
Mount Lebanon	CHOUF	Krisse	الكريسة	860
Mount Lebanon	CHOUF	Lahbiye	اللاهية	850
Mount Lebanon	CHOUF	Maaniye	المعينة	850
Mount Lebanon	CHOUF	Maaser Beit ed Dine	معاسر بيت الدين	1030
Mount Lebanon	CHOUF	Maasser ech Chouf	معاسر الشوف	1175
Mount Lebanon	CHOUF	Majdlouna	مجدلونا	850
Mount Lebanon	CHOUF	Majdel el Meouch	مجدل الموش	1010
Mount Lebanon	CHOUF	Margabe	المربية	850
Mount Lebanon	CHOUF	Mar Mikhayel Bnabil	مار ميخائيل	850
Mount Lebanon	CHOUF	Marjayat	المرجات	880
Mount Lebanon	CHOUF	Mazboub	مزبوع	850
Mount Lebanon	CHOUF	Mazmoua	مزموزة	895
Mount Lebanon	CHOUF	Maaraat El Baighoutiyeh	مزارعة الباغوتية	850
Mount Lebanon	CHOUF	Maaraat El Chouf	مزارعة الشوف	1070
Mount Lebanon	CHOUF	Maaraat el Dahr	مزارعة الدهر	925
Mount Lebanon	CHOUF	Maaraat El Dahr	مزارعة الدهر	875
Mount Lebanon	CHOUF	Maaraat El Naher	مزارعة النهر	850
Mount Lebanon	CHOUF	Mechref	المشرف	850
Mount Lebanon	CHOUF	Mghairiyeh	المغرية	850
Mount Lebanon	CHOUF	Mouhtraya	موشترية	850
Mount Lebanon	CHOUF	Moukhtara	المشخرة	1025
Mount Lebanon	CHOUF	Mqifti	مقفتي	900



RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	CHOUF	Mtassleh	متبلة	975
Mount Lebanon	CHOUF	Mistqi	مستقي	1100
Mount Lebanon	CHOUF	Naaame	ناعمة	850
Mount Lebanon	CHOUF	Nabaa El Barouq	نبع الباروق	1150
Mount Lebanon	CHOUF	Nabaa El Kharroubeh	نبع الخروبة	850
Mount Lebanon	CHOUF	Nabaa El Safa	نبع الصفا	1125
Mount Lebanon	CHOUF	Niha	نيحا	1110
Mount Lebanon	CHOUF	Quadi Bahlle	وادي بعلبلة	850
Mount Lebanon	CHOUF	Quadi ed Deir	وادي القبر	850
Mount Lebanon	CHOUF	Quadi es Sitt	وادي الست	900
Mount Lebanon	CHOUF	Quarhaniye	قورحانية	1130
Mount Lebanon	CHOUF	Qassoubie	قاصوبية	850
Mount Lebanon	CHOUF	Qatilt Issa	قطيلة عيسى	850
Mount Lebanon	CHOUF	Quardaniye	قورحانية	850
Mount Lebanon	CHOUF	Raboun	رَبُون	965
Mount Lebanon	CHOUF	Ras El Nabi Youmiss	رأس النبي يونس	850
Mount Lebanon	CHOUF	Rimalle (er)	الرميلة	850
Mount Lebanon	CHOUF	Saadqat	السديقات	850
Mount Lebanon	CHOUF	Sabouniyeh	صابونية	850
Mount Lebanon	CHOUF	Safa	صفا	1062
Mount Lebanon	CHOUF	Simganiye	السقانيية	1060
Mount Lebanon	CHOUF	Siblne	سبلان	850
Mount Lebanon	CHOUF	Sirbaal	سرجبال	850
Mount Lebanon	CHOUF	Souwaneh	سوانيه	850
Mount Lebanon	CHOUF	Wadi Abou Youssef	وادي أبو يوسف	850
Mount Lebanon	CHOUF	Wadi Deir Douff	وادي دير دوف	850
Mount Lebanon	CHOUF	Wadi El Zaimeh	وادي الزيمة	850
Mount Lebanon	CHOUF	Yarouteh	ياروتيه	850
Mount Lebanon	CHOUF	Zaaruniye	الزعرونية	935
Mount Lebanon	EL METN	Aairoun	عيرون	1070
Mount Lebanon	EL METN	Aamret Chalhoub	عمر و شحوب	850
Mount Lebanon	EL METN	Aatchane	العطاشية	950
Mount Lebanon	EL METN	Awkar	عوكر	850
Mount Lebanon	EL METN	Abou Mizane	أبو ميزان	960
Mount Lebanon	EL METN	Allout	علوت	850
Mount Lebanon	EL METN	Ain Araq	عين عرق	965
Mount Lebanon	EL METN	Ain Aar	عين عار	905
Mount Lebanon	EL METN	Ain El Hage Elias	عين الحاج إلياس	1165
Mount Lebanon	EL METN	Ain El Kharroube	عين الخروبة	965
Mount Lebanon	EL METN	Ain El Uchr	عين العنق	1065
Mount Lebanon	EL METN	Ain El Qabou	عين القو	1165
Mount Lebanon	EL METN	Ain El Safsaf	عين السفساف	1125
Mount Lebanon	EL METN	Ain El Sindiane	عين السديانة	1125
Mount Lebanon	EL METN	Ain El Toufaha	عين التوفاحا	1165
Mount Lebanon	EL METN	Ain El Zaitouneh	عين الزيتونة	1175
Mount Lebanon	EL METN	Ain Najm	عين نجم	867
Mount Lebanon	EL METN	Ain Saadé	عين السادة	905
Mount Lebanon	EL METN	Airtoura	عيطارة	1100
Mount Lebanon	EL METN	Alyoun	القون	940
Mount Lebanon	EL METN	Baabat	بغات	1025
Mount Lebanon	EL METN	Baaqif	بقر بيف	930
Mount Lebanon	EL METN	Balouaa	بلواعة	1170
Mount Lebanon	EL METN	Baouchriye	البرشيرة	850
Mount Lebanon	EL METN	Bqaatoh El Nieher	بعلقطة النهر	1175
Mount Lebanon	EL METN	Baskinta	بسكيتا	1100
Mount Lebanon	EL METN	Beit Aayal	بيت عيال	1090
Mount Lebanon	EL METN	Beit Chebab	بيت شباب	915
Mount Lebanon	EL METN	Beit Ech Chaar	بيت الشعار	850
Mount Lebanon	EL METN	Beit El Koukkp	بيت كوكو	895
Mount Lebanon	EL METN	Beit Meri	بيت ميري	970
Mount Lebanon	EL METN	Belvo	بلفو	850
Mount Lebanon	EL METN	Bhanis	بھانس	1135
Mount Lebanon	EL METN	Bharsaf	بھارساف	1080
Mount Lebanon	EL METN	Bherdoq	بھردوق	850
Mount Lebanon	EL METN	Blaqout	بلقوت	850
Mount Lebanon	EL METN	Blkfayka	بلقفا	1055
Mount Lebanon	EL METN	Bnabil	بنابل	850
Mount Lebanon	EL METN	Bolonia	بولونيا	1100
Mount Lebanon	EL METN	Borj Hammoud	بورج حمود	850
Mount Lebanon	EL METN	Bqallayaa	بقلية	1100
Mount Lebanon	EL METN	Bgenmaya	بغنا	850
Mount Lebanon	EL METN	Broumana	برونما	990
Mount Lebanon	EL METN	Bsalim	بساليم	850
Mount Lebanon	EL METN	Bsifrin	بسفرين	922
Mount Lebanon	EL METN	Btegrine	بتهرين	1075
Mount Lebanon	EL METN	Chaoulye	شاولية	865
Mount Lebanon	EL METN	Chirchar	شوشار	1087
Mount Lebanon	EL METN	Chouaiya	شوايا	1110
Mount Lebanon	EL METN	Choueir	شوير	1100
Mount Lebanon	EL METN	Chraim	شرايم	1065
Mount Lebanon	EL METN	Daher El Bacheq	دھير الباشق	850
Mount Lebanon	EL METN	Daher El Housain	دھير الحوسين	850
Mount Lebanon	EL METN	Dahr El Souane	دھر السوان	1060
Mount Lebanon	EL METN	Dibaïye	دبایيه	850
Mount Lebanon	EL METN	Deir Chaimra	دير شمرأ	905
Mount Lebanon	EL METN	Deir El Qalaa	دير القلعة	965
Mount Lebanon	EL METN	Deir El Silib	دير الصليب	850
Mount Lebanon	EL METN	Deir Mar Aabds (EL Mchamar)	دير مار عبا (المشمار)	850
Mount Lebanon	EL METN	Deir Mar Botros (Kraïm El Tin)	دير مار بوترس (كرايم التين)	965
Mount Lebanon	EL METN	Deir Mar Doumed	دير مار دوسمط	865
Mount Lebanon	EL METN	Deir Mar Elias (Chwaya)	دير مار إلياس (شوايا)	1125
Mount Lebanon	EL METN	Deir Mar Jerjes ( Awkar)	دير مار جرجس (عوكر)	850
Mount Lebanon	EL METN	Deir Mar Mansour	دير مار منصور	1115
Mount Lebanon	EL METN	Deir Mar Maroun (El Qnaltra)	دير مار مارون (القنطرة)	925
Mount Lebanon	EL METN	Deir Mar Mikhaïl	دير مار ميخائيل (بقر صاف)	1030
Mount Lebanon	EL METN	Deir Mar Salsine (Baskenta)	دير مار سالسين (بسكيتا)	1100
Mount Lebanon	EL METN	Deir Mar Simaane	دير مار سيمان	1165
Mount Lebanon	EL METN	Deir Mar Smaane (Wadi El Karm)	دير مار سيمان وادي الكرم	1160
Mount Lebanon	EL METN	Deir Mar Youhanna (El Sabegh)	دير مار يوحنا (الصبع)	1065
Mount Lebanon	EL METN	Deir Mar Youssef (El Borj)	دير مار يوسف (البرج)	850
Mount Lebanon	EL METN	Deir Tamich	دير تميمش	850
Mount Lebanon	EL METN	Dekouane	دقوانه	850
Mount Lebanon	EL METN	Dhour Ech Choueir	شهور الشوير	1100
Mount Lebanon	EL METN	Dik El Mehdi	ديك المھدي	850
Mount Lebanon	EL METN	Douar	دوار	1175
Mount Lebanon	EL METN	El Aaraar	العرار	1075
Mount Lebanon	EL METN	El Ammaniya	العمانية	850
Mount Lebanon	EL METN	El Aaqabel	العاقبة	850
Mount Lebanon	EL METN	El Aayoun	العيون	945
Mount Lebanon	EL METN	El Borj	البرج	850
Mount Lebanon	EL METN	El Chakroub	الشكروب	1100

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	CHOUF	Mtassleh	متبلة	975
Mount Lebanon	CHOUF	Mistqi	مستقي	1100
Mount Lebanon	CHOUF	Naaame	ناعمة	850
Mount Lebanon	CHOUF	Nabaa El Barouq	نبع الباروق	1150
Mount Lebanon	CHOUF	Nabaa El Kharroubeh	نبع الخروبة	850
Mount Lebanon	CHOUF	Nabaa El Safa	نبع الصفا	1125
Mount Lebanon	CHOUF	Niha	نيحا	1110
Mount Lebanon	CHOUF	Quadi Bahlle	وادي بعلبلة	850
Mount Lebanon	CHOUF	Quadi ed Deir	وادي القبر	850
Mount Lebanon	CHOUF	Quadi es Sitt	وادي الست	900
Mount Lebanon	CHOUF	Quarhaniye	قورحانية	1130
Mount Lebanon	CHOUF	Qassoubie	قاصوبية	850
Mount Lebanon	CHOUF	Qatilt Issa	قطيلة عيسى	850
Mount Lebanon	CHOUF	Quardaniye	قورحانية	850
Mount Lebanon	CHOUF	Raboun	رَبُون	965
Mount Lebanon	CHOUF	Ras El Nabi Youmiss	رأس النبي يونس	850
Mount Lebanon	CHOUF	Rimalle (er)	الرميلة	850
Mount Lebanon	CHOUF	Saadqat	السديقات	850
Mount Lebanon	CHOUF	Sabouniyeh	صابونية	850
Mount Lebanon	CHOUF	Safa	صفا	1062
Mount Lebanon	CHOUF	Simganiye	السقانيية	1060
Mount Lebanon	CHOUF	Siblne	سبلان	850
Mount Lebanon	CHOUF	Sirbaal	سرجبال	850
Mount Lebanon	CHOUF	Souwaneh	سوانيه	850
Mount Lebanon	CHOUF	Wadi Abou Youssef	وادي أبو يوسف	850
Mount Lebanon	CHOUF	Wadi Deir Douff	وادي دير دوف	850
Mount Lebanon	CHOUF	Wadi El Zaimeh	وادي الزيمة	850
Mount Lebanon	CHOUF	Yarouteh	ياروتيه	850
Mount Lebanon	CHOUF	Zaaruniye	الزعرونية	935
Mount Lebanon	EL METN	Aairoun	عيرون	1070
Mount Lebanon	EL METN	Aamret Chalhoub	عمر و شحوب	850
Mount Lebanon	EL METN	Aatchane	العطاشية	950
Mount Lebanon	EL METN	Awkar	عوكر	850
Mount Lebanon	EL METN	Abou Mizane	أبو ميزان	960
Mount Lebanon	EL METN	Allout	علوت	850
Mount Lebanon	EL METN	Ain Araq	عين عرق	965
Mount Lebanon	EL METN	Ain Aar	عين عار	905
Mount Lebanon	EL METN	Ain El Hage Elias	عين الحاج إلياس	1165
Mount Lebanon	EL METN	Ain El Kharroube	عين الخروبة	965
Mount Lebanon	EL METN	Ain El Uchr	عين العنق	1065
Mount Lebanon	EL METN	Ain El Qabou	عين القو	1165
Mount Lebanon	EL METN	Ain El Safsaf	عين السفساف	1125
Mount Lebanon	EL METN	Ain El Sindiane	عين السديانة	1125
Mount Lebanon	EL METN	Ain El Toufaha	عين التوفاحا	1165
Mount Lebanon	EL METN	Ain El Zaitouneh	عين الزيتونة	1175
Mount Lebanon	EL METN	Ain Najm	عين نجم	867
Mount Lebanon	EL METN	Ain Saadé	عين السادة	905
Mount Lebanon	EL METN	Airtoura	عيطارة	1100
Mount Lebanon	EL METN	Alyoun	القون	940
Mount Lebanon	EL METN	Baabat	بغات	1025
Mount Lebanon	EL METN	Baaqif	بقر بيف	930
Mount Lebanon	EL METN	Balouaa	بلواعة	1170
Mount Lebanon	EL METN	Baouchriye	البرشيرة	850
Mount Lebanon	EL METN	Bqaatoh El Nieher	بعلقطة النهر	1175
Mount Lebanon	EL METN	Baskinta	بسكيتا	1100
Mount Lebanon	EL METN	Beit Aayal	بيت عيال	1090



RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	الموقع	Rainfall
Mount Lebanon	EL METN	El Chamris	الشحش	850
Mount Lebanon	EL METN	El Chwir	الشوير	1137
Mount Lebanon	EL METN	El Chwyeh	الشويه	860
Mount Lebanon	EL METN	El Dawra	الدورة	850
Mount Lebanon	EL METN	El Daychouniyeh	الديحونية	850
Mount Lebanon	EL METN	El Faids	الفايد	1100
Mount Lebanon	EL METN	El Fardaws	الفردوس	850
Mount Lebanon	EL METN	El Ghawbat	الغوابت	850
Mount Lebanon	EL METN	El Ghazalbeh	الغازلbeh	850
Mount Lebanon	EL METN	El Hadira	الحضرة	850
Mount Lebanon	EL METN	El Jouweniyeh	الجوينيه	850
Mount Lebanon	EL METN	El Khalch	الخالچ	1115
Mount Lebanon	EL METN	El Khejjan	الخجان	850
Mount Lebanon	EL METN	El Mangalieh	المنجله	850
Mount Lebanon	EL METN	El Moukhdada	المخاضه	850
Mount Lebanon	EL METN	El Mountazah	المنزه	850
Mount Lebanon	EL METN	El Mourrach	المراش	850
Mount Lebanon	EL METN	El Moukhdada	المخاضه	850
Mount Lebanon	EL METN	El Mtakeh	المتكه	1000
Mount Lebanon	EL METN	El Naa's	النص	1100
Mount Lebanon	EL METN	El Qalaa	القلعه	850
Mount Lebanon	EL METN	El Qalaa	القلعه	1125
Mount Lebanon	EL METN	El Qnaitra	القنيطره	925
Mount Lebanon	EL METN	El Ra'wa	الراويه	850
Mount Lebanon	EL METN	El Babiyeh	البابيه	850
Mount Lebanon	EL METN	El Raqayeq	الراقيق	1100
Mount Lebanon	EL METN	El Rifalilyeh	الريفليه	855
Mount Lebanon	EL METN	El Rwabseh	الروابسه	850
Mount Lebanon	EL METN	El Tabche	الطبخه	1090
Mount Lebanon	EL METN	El Wala	الولاه	1025
Mount Lebanon	EL METN	El Zaaitryeh	الزاعتره	850
Mount Lebanon	EL METN	El Zaour	الزاور	1100
Mount Lebanon	EL METN	Fannar	الفانار	850
Mount Lebanon	EL METN	Fawar Antillias	فوار انطيليس	850
Mount Lebanon	EL METN	Fraike	الفرايكه	850
Mount Lebanon	EL METN	Ghabe	الغابه	1100
Mount Lebanon	EL METN	Hamlaya	حملايا	1000
Mount Lebanon	EL METN	Haret Chalhoub	حارة شلوب	850
Mount Lebanon	EL METN	Haret el Bellane	حارة بلان	850
Mount Lebanon	EL METN	Haret El Cheikh	حارة الشيخ	850
Mount Lebanon	EL METN	Haret El Ghwarmeh	حارة الغورمه	850
Mount Lebanon	EL METN	Haret Wazen	حارة وازن	850
Mount Lebanon	EL METN	Hibous	الحبوس	850
Mount Lebanon	EL METN	Imbilias	اليميليس	850
Mount Lebanon	EL METN	Jabal Sannin	جبل صنين	1100
Mount Lebanon	EL METN	Jail Ed Dib	جبل الديب	850
Mount Lebanon	EL METN	Jail Hsain	جبل حصين	850
Mount Lebanon	EL METN	Jdside	الجديسه	850
Mount Lebanon	EL METN	Jisr El Bascha	جسر الباشا	850
Mount Lebanon	EL METN	Jouar	الجوار	1065
Mount Lebanon	EL METN	Jourer El Ballout	جورير البلقوط	915
Mount Lebanon	EL METN	Kafra	كفرا	990
Mount Lebanon	EL METN	Kfar Aaqab	كفر اعقاب	1160
Mount Lebanon	EL METN	Kfartay	كفرتاي	1135
Mount Lebanon	EL METN	Khrenchara	خنقره	1135

Mount Lebanon	EL METN	Kherbet El Aaldas	حرة العادس	850
Mount Lebanon	EL METN	Machraa	المشراخ	1100
Mount Lebanon	EL METN	Majdel Tarchich	مجدل تارشيش	1100
Mount Lebanon	EL METN	Majdoub	مجدوب	850
Mount Lebanon	EL METN	Mansouriyeh	منصوريه	850
Mount Lebanon	EL METN	Mar Boutrous Karm Et Tine	مار بطروس كرم الكرم	965
Mount Lebanon	EL METN	Mar Chabiyeh	مار شحيا	1090
Mount Lebanon	EL METN	Mar Challita	مار شليليا	1100
Mount Lebanon	EL METN	Mar Mkhayel Boabil	مار مخيال	1150
Mount Lebanon	EL METN	Mar Mousa Ed Daouar	مار موسى(الدار)	1080
Mount Lebanon	EL METN	Mar Nohra	مار نهورا	850
Mount Lebanon	EL METN	Mar Youhana (Zikrit)	مار يوحنا (زكريت)	850
Mount Lebanon	EL METN	Marj Baskenta	مراج بسكنتا	1100
Mount Lebanon	EL METN	Marjaba	مراجبا	1170
Mount Lebanon	EL METN	Masqa	المسقي	915
Mount Lebanon	EL METN	Mayasse	ماياسه	990
Mount Lebanon	EL METN	Mazraat Babil	مزرعه بابل	1125
Mount Lebanon	EL METN	Mazraat Deir Aoukar	مزرعه دير عوكر	850
Mount Lebanon	EL METN	Mazraat El Nakhe	مزرعه النخه	1100
Mount Lebanon	EL METN	Mazraat Yachoua	مزرعه ياشوخ	910
Mount Lebanon	EL METN	Mchekha	مشيخا	1050
Mount Lebanon	EL METN	Mhaydsie	مخيدسه	1075
Mount Lebanon	EL METN	Mkailless	مكليس	850
Mount Lebanon	EL METN	Montefardi	مونترفاردي	850
Mount Lebanon	EL METN	Mrah Gharnem	مراج غارنم	950
Mount Lebanon	EL METN	Mrouj	المروج	1100
Mount Lebanon	EL METN	Mtalieb	مطليب	850
Mount Lebanon	EL METN	Mtein	المطين	1140
Mount Lebanon	EL METN	Nabaa El Jwaizat	نبع الجوايز	1100
Mount Lebanon	EL METN	Nabaa El Memboukh	نبع المنبوخ	1100
Mount Lebanon	EL METN	Nabaa Sanin	نبع صنين	1100
Mount Lebanon	EL METN	Nabay	نبايه	850
Mount Lebanon	EL METN	Naqqach	نقاش	850
Mount Lebanon	EL METN	Osalbe	عسليه	950
Mount Lebanon	EL METN	Ouadi Chahine	وادي شاحين	920
Mount Lebanon	EL METN	Ouadi El karm	وادي الكرم	1180
Mount Lebanon	EL METN	Ouata El Mrouj	وهي المروج	1100
Mount Lebanon	EL METN	Qaaqour	القاقور	1065
Mount Lebanon	EL METN	Qanabet Salima	قنابته صليما	990
Mount Lebanon	EL METN	Qarat Balch	قنات بلكش	1100
Mount Lebanon	EL METN	Qemabet Broummana	قنابته بزمنا	880
Mount Lebanon	EL METN	Qornet Chahouane	قرنة شحوان	920
Mount Lebanon	EL METN	Qornet El Hamra	قرنة الحمرا	850
Mount Lebanon	EL METN	Ramyieh	رابعيه	850
Mount Lebanon	EL METN	Roumie	رؤميه	990
Mount Lebanon	EL METN	Sad el Baouchrye	سد الباشريه	850
Mount Lebanon	EL METN	Samine	صافين	1100
Mount Lebanon	EL METN	Segell El Misk	سجيلة المسك	1050
Mount Lebanon	EL METN	Sin El Fil	سن الفيل	850
Mount Lebanon	EL METN	Stalle	ستاليه	940
Mount Lebanon	EL METN	Tall et Zaatar	تل الزعتر	850
Mount Lebanon	EL METN	Tallit Aaranta	تله غزنا	1095
Mount Lebanon	EL METN	Wadi El Dib	وادي الديب	1100
Mount Lebanon	EL METN	Wadi El Jama'iem	وادي الجامعيه	900
Mount Lebanon	EL METN	Zabbouha	زبوحا	1100
Mount Lebanon	EL METN	Zaghine	زغرين	1115



RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	EL METN	Zahriye	الزهرية	910
Mount Lebanon	EL METN	Zalqa	الزقا	850
Mount Lebanon	EL METN	Zaraoun	زرعون	1115
Mount Lebanon	EL METN	Zikrit	زكريت	850
Mount Lebanon	EL METN	Ziraaya	زرعيا	1125
Mount Lebanon	EL METN	Zouk el Kharab	زوك الخراب	850
Mount Lebanon	JUBAIL	Aalbeidat	عبيات	925
Mount Lebanon	JUBAIL	Aaboud	عبد	1170
Mount Lebanon	JUBAIL	Aayoun El Ablaq	عقون العلق	1100
Mount Lebanon	JUBAIL	Aaidmoun	عيدمون	850
Mount Lebanon	JUBAIL	Ain El Batraq	عين البتراق	1100
Mount Lebanon	JUBAIL	Ain El Chailai	عين الشلال	1100
Mount Lebanon	JUBAIL	Ain El Deir	عين دير	1137
Mount Lebanon	JUBAIL	Ain Qara	عين قارة	1100
Mount Lebanon	JUBAIL	Ain Qouna	عين قونا	1100
Mount Lebanon	JUBAIL	Ain El Souwaneh	عين السوانة	1112
Mount Lebanon	JUBAIL	Aainat	عبيات	850
Mount Lebanon	JUBAIL	Aalita	عليا	925
Mount Lebanon	JUBAIL	Aarmchit	عشيت	850
Mount Lebanon	JUBAIL	Aannaya	عليا	1195
Mount Lebanon	JUBAIL	Aapoura	العقورة	1100
Mount Lebanon	JUBAIL	Aarab El Laqlouq	عرب القلق	1100
Mount Lebanon	JUBAIL	Aarab el Uhib	عرب الهيب	1100
Mount Lebanon	JUBAIL	Aarasta	عراستا	1135
Mount Lebanon	JUBAIL	Aaraba	عرابا	850
Mount Lebanon	JUBAIL	Adonis	ادونيس	850
Mount Lebanon	JUBAIL	Alqa	القا	1100
Mount Lebanon	JUBAIL	Ain Ed Deibe	عين الديبة	1110
Mount Lebanon	JUBAIL	Ain El Ghoulbe	عين الغولبة	1125
Mount Lebanon	JUBAIL	Ain Jraïn	عين جرين	1085
Mount Lebanon	JUBAIL	Ain Kfaa	عين كفا	850
Mount Lebanon	JUBAIL	Almat ech Chermaliye	علمات السامرة	1055
Mount Lebanon	JUBAIL	Almat Et Jnoubiye	علمات الجنوبية	1055
Mount Lebanon	JUBAIL	Arez Jaj	ارزجاج	1100
Mount Lebanon	JUBAIL	Arnia	ارنيا	885
Mount Lebanon	JUBAIL	Baachita	بشخا	850
Mount Lebanon	JUBAIL	Barbara	بشارا	1100
Mount Lebanon	JUBAIL	Bahra	البحرا	1100
Mount Lebanon	JUBAIL	Balhoss	البخوس	1165
Mount Lebanon	JUBAIL	Barbara	الباربا	850
Mount Lebanon	JUBAIL	Bchelli	بشلي	875
Mount Lebanon	JUBAIL	Bechtielida	بشكيليا	1060
Mount Lebanon	JUBAIL	Behdaldat	بهدالداط	850
Mount Lebanon	JUBAIL	Beit El Boume	بيت البومة	850
Mount Lebanon	JUBAIL	Beit Hbaq	بيت حباق	875
Mount Lebanon	JUBAIL	Beije	بيجة	850
Mount Lebanon	JUBAIL	Bekhaaz	بشخاز	850
Mount Lebanon	JUBAIL	Berzaael	بشراعل	860
Mount Lebanon	JUBAIL	Berkit Hijoula	بركة حيولا	940
Mount Lebanon	JUBAIL	Bezyoun	بزيون	990
Mount Lebanon	JUBAIL	Bikwen	بيقون	850
Mount Lebanon	JUBAIL	Bir El Hait	بير الهيت	985
Mount Lebanon	JUBAIL	Bkerta	بكرتا	1100
Mount Lebanon	JUBAIL	Blat	بلط	850
Mount Lebanon	JUBAIL	Bmehrain	بمهراين	850
Mount Lebanon	JUBAIL	Boechich	بوشيش	1100

Mount Lebanon	JUBAIL	Braij	بريج	850
Mount Lebanon	JUBAIL	Charbiet El Fawqa	شبابية الفوقا	850
Mount Lebanon	JUBAIL	Chamat	شامات	850
Mount Lebanon	JUBAIL	Chammis El Kazah	شامين الكازح	1100
Mount Lebanon	JUBAIL	Charbine	الشربينة	1100
Mount Lebanon	JUBAIL	Chakhnia	شخنيا	850
Mount Lebanon	JUBAIL	Chihane	شبخان	990
Mount Lebanon	JUBAIL	Chlomas	شولماس	850
Mount Lebanon	JUBAIL	Chmout	شموت	850
Mount Lebanon	JUBAIL	Chqif	شقيف	850
Mount Lebanon	JUBAIL	Chwata	شوتا	1100
Mount Lebanon	JUBAIL	Daher Saria	صنهر صوريا	900
Mount Lebanon	JUBAIL	Deir El Arbaïn Shahid	دير الاربعين شهيد	850
Mount Lebanon	JUBAIL	Deir Mar Aabds (Meaad)	دير مار عبا (معاذ)	862
Mount Lebanon	JUBAIL	Deir Mar Chaifita (El Qoutara)	دير مار شايقا (عطارا)	1140
Mount Lebanon	JUBAIL	Deir Mar Ghalab	دير مار غلاب	850
Mount Lebanon	JUBAIL	Deir Mar Mamsa	دير مار ماما	887
Mount Lebanon	JUBAIL	Deir Mar Maroun (Aamaya)	دير مار مارون (عليا)	1175
Mount Lebanon	JUBAIL	Deir Mar Sarkis w Bakhos (qortouba)	دير مار سركيس وباكوس (قربا)	1157
Mount Lebanon	JUBAIL	Deir Mar Sofita	دير مار صوفيا	850
Mount Lebanon	JUBAIL	Deir el Qattara	دير القطارا	1140
Mount Lebanon	JUBAIL	Deir Sayedet El Marounat (Deir El Banat)	دير سيدة المرونات (دير البنات)	850
Mount Lebanon	JUBAIL	Dimalsa	دلمسا	860
Mount Lebanon	JUBAIL	Douwar Bou Chahine	دوار بو شاهين	1100
Mount Lebanon	JUBAIL	Eddle	يد	850
Mount Lebanon	JUBAIL	Ehmej	عجم	1170
Mount Lebanon	JUBAIL	El Aafes	العفس	850
Mount Lebanon	JUBAIL	El Aarich	العريش	1100
Mount Lebanon	JUBAIL	El Aarwalinl	العروين	1100
Mount Lebanon	JUBAIL	El Biad	البياض	850
Mount Lebanon	JUBAIL	El Souppa	الطبة	850
Mount Lebanon	JUBAIL	El Braij	البريج	950
Mount Lebanon	JUBAIL	El Borj	البرج	850
Mount Lebanon	JUBAIL	El Charwi	الشوي	1100
Mount Lebanon	JUBAIL	El Daouq	داوق	1100
Mount Lebanon	JUBAIL	El Dawra	الدورة	850
Mount Lebanon	JUBAIL	El Dwair	الدوير	850
Mount Lebanon	JUBAIL	El Haitoun	الحايزون	1075
Mount Lebanon	JUBAIL	El Housainat	الحسينات	1100
Mount Lebanon	JUBAIL	El Housssoun	الحوسون	975
Mount Lebanon	JUBAIL	El Hraigt	الحرايقت	1120
Mount Lebanon	JUBAIL	El Hrazmil	الحرازميل	1195
Mount Lebanon	JUBAIL	El Hirouf	الحزوف	855
Mount Lebanon	JUBAIL	El Kafir	الكفر	850
Mount Lebanon	JUBAIL	El Ksar	القسار	1150
Mount Lebanon	JUBAIL	El Meloukh	المسلوخ	850
Mount Lebanon	JUBAIL	El Mnaitra	المنيطرة	1100
Mount Lebanon	JUBAIL	El Mezraa	المزعة	850
Mount Lebanon	JUBAIL	El Meaden	المعدان	1180
Mount Lebanon	JUBAIL	El Masarib	المساريب	1125
Mount Lebanon	JUBAIL	El Moukharda	الموكردة	1100
Mount Lebanon	JUBAIL	El Naqour	النقور	850
Mount Lebanon	JUBAIL	El Qamoussa	القمرسة	1100
Mount Lebanon	JUBAIL	El Qarouf	القرف	1185
Mount Lebanon	JUBAIL	El Qate'	القاع	850
Mount Lebanon	JUBAIL	El Qhaf	القحاف	1100
Mount Lebanon	JUBAIL	El Qmeira	القمية	850

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	JUBAIL	El Qortara	القارة	1125
Mount Lebanon	JUBAIL	El Qortine	القطين	905
Mount Lebanon	JUBAIL	El Rmalieh	الرمية	1100
Mount Lebanon	JUBAIL	El Rweis	الراوس	1100
Mount Lebanon	JUBAIL	El Sigi	السقي	970
Mount Lebanon	JUBAIL	El Wata	الوطى	850
Mount Lebanon	JUBAIL	El Wata	الوطى	1100
Mount Lebanon	JUBAIL	Fare	فاره	850
Mount Lebanon	JUBAIL	Faire	فاري	850
Mount Lebanon	JUBAIL	Fdar El alta	فدار العتا	850
Mount Lebanon	JUBAIL	Fdar El Fawga	فدار الفوقا	875
Mount Lebanon	JUBAIL	Ferhest	فرحت	990
Mount Lebanon	JUBAIL	Fghal	فغال	850
Mount Lebanon	JUBAIL	Fidar	فدار	850
Mount Lebanon	JUBAIL	Frat	فراط	1000
Mount Lebanon	JUBAIL	Ghabet	غابوت	1115
Mount Lebanon	JUBAIL	Ghalboun	غلبون	850
Mount Lebanon	JUBAIL	Gharfne	غرفين	850
Mount Lebanon	JUBAIL	Gharrouz	غرزوز	850
Mount Lebanon	JUBAIL	Ghbaline	غبالين	850
Mount Lebanon	JUBAIL	Ghboub	غوب	850
Mount Lebanon	JUBAIL	Habil	هابيل	975
Mount Lebanon	JUBAIL	Hajat	حاجات	850
Mount Lebanon	JUBAIL	Hajlit	حاجلث	935
Mount Lebanon	JUBAIL	Haqlit El Tine	حقلث التينة	875
Mount Lebanon	JUBAIL	Hbalin	حبالين	850
Mount Lebanon	JUBAIL	Hdaine	هداينة	1120
Mount Lebanon	JUBAIL	Heloue	هلولة	850
Mount Lebanon	JUBAIL	Hjoula	حجولا	1060
Mount Lebanon	JUBAIL	Horch	حورثا	910
Mount Lebanon	JUBAIL	Hosn Aar	حوسن عار	1025
Mount Lebanon	JUBAIL	Hosna	حوسنا	1055
Mount Lebanon	JUBAIL	Hourayel	حوراييل	850
Mount Lebanon	JUBAIL	Hsarat	حسارات	850
Mount Lebanon	JUBAIL	Ilij	اليج	1100
Mount Lebanon	JUBAIL	Jabal El Mnaitra	جبل المنيرة	1100
Mount Lebanon	JUBAIL	Jaj	جاج	1100
Mount Lebanon	JUBAIL	Jarne	جانه	950
Mount Lebanon	JUBAIL	Jbail	جبيل	850
Mount Lebanon	JUBAIL	Jdayel	جدال	850
Mount Lebanon	JUBAIL	Jesser El Djei	جسر الدجاج	850
Mount Lebanon	JUBAIL	Jilbab	جبيل	860
Mount Lebanon	JUBAIL	Jinjel	جنبل	850
Mount Lebanon	JUBAIL	Jlaisse	اللبسة	880
Mount Lebanon	JUBAIL	Jourat El Qattine	جوراة القطين	905
Mount Lebanon	JUBAIL	Jouret El Moutran	جوراة الموران	1100
Mount Lebanon	JUBAIL	Jrabta	جربتا	925
Mount Lebanon	JUBAIL	Kafe	كافه	850
Mount Lebanon	JUBAIL	Kalach	كلاح	1100
Mount Lebanon	JUBAIL	Kiar Baal	كيار بعال	1060
Mount Lebanon	JUBAIL	Kiar Chilli	كيار شيلي	1125
Mount Lebanon	JUBAIL	Kiar Chkhal	كيار شخال	850
Mount Lebanon	JUBAIL	Kiar Hatta	كيار حاتا	850
Mount Lebanon	JUBAIL	Kfar Ribal	كفر ريبال	1075
Mount Lebanon	JUBAIL	Kfar Kekhhe	كفر كخه	850
Mount Lebanon	JUBAIL	Kfar Killas	كفر كلاس	850
Mount Lebanon	JUBAIL	Kfar Kiola	كفر كولا	850
Mount Lebanon	JUBAIL	Kfar Meshoun	كفر مشون	850
Mount Lebanon	JUBAIL	Kfar Mill	كفر ميلي	1125
Mount Lebanon	JUBAIL	Kfar Qaouss	كفر قاوس	940
Mount Lebanon	JUBAIL	Kfar Sali	كفر سالي	850
Mount Lebanon	JUBAIL	Kfar Salada	كفر سالتا	850
Mount Lebanon	JUBAIL	Kfar Zbouna	كفر زبونا	850
Mount Lebanon	JUBAIL	Kfour	كفرون	850
Mount Lebanon	JUBAIL	Khaabia	خابيا	1180
Mount Lebanon	JUBAIL	Kharbe	الخابزة	955
Mount Lebanon	JUBAIL	Kirkoz	كركوز	990
Mount Lebanon	JUBAIL	Koukadan	كوكدان	1117
Mount Lebanon	JUBAIL	Kour El Hououa	كور الهوا	850
Mount Lebanon	JUBAIL	Lajlouj	اللقوق	1100
Mount Lebanon	JUBAIL	Lassa	لاسا	1165
Mount Lebanon	JUBAIL	Lehfed	لحفد	1085
Mount Lebanon	JUBAIL	Mead	معد	855
Mount Lebanon	JUBAIL	Maatliq	ماتليق	850
Mount Lebanon	JUBAIL	Maehlan	معايلان	850
Mount Lebanon	JUBAIL	Machnaga	مشناجا	1125
Mount Lebanon	JUBAIL	Maifouq	مافوق	1090
Mount Lebanon	JUBAIL	Majdel	المجل	1100
Mount Lebanon	JUBAIL	Mar Edna	مار انا	1100
Mount Lebanon	JUBAIL	Mar Iachaa	مار ياشع	1162
Mount Lebanon	JUBAIL	Mar Youhana	مار يوحنا	850
Mount Lebanon	JUBAIL	Marraat El Ain	مرازع العين	1000
Mount Lebanon	JUBAIL	Marraat El Haj Khalil	مرازع الحاج خليل	872
Mount Lebanon	JUBAIL	Marraat El Jmail	مرازع الجميل	850
Mount Lebanon	JUBAIL	Marraat El Syad	مرازع السيد	1170
Mount Lebanon	JUBAIL	Mdarmit	مدارميت	865
Mount Lebanon	JUBAIL	Mechane	مشان	850
Mount Lebanon	JUBAIL	MechMech	مشان	1100
Mount Lebanon	JUBAIL	Mestita	مستيا	850
Mount Lebanon	JUBAIL	Mghaira	المغري	1180
Mount Lebanon	JUBAIL	Mhamaret Bejjeh	محمرة بجة	960
Mount Lebanon	JUBAIL	Mofrah El Selameh	مفتاح السلامة	850
Mount Lebanon	JUBAIL	Monsef	المنصف	850
Mount Lebanon	JUBAIL	Mrah Sghir	مراح صغير	1000
Mount Lebanon	JUBAIL	Nabaa Afqa	نابعا افقا	1182
Mount Lebanon	JUBAIL	Nabaa El Rweis	نابعا الراوس	1100
Mount Lebanon	JUBAIL	Nahr Ibrahim	نهر ابراهيم	850
Mount Lebanon	JUBAIL	Nawfal	نوافل	1100
Mount Lebanon	JUBAIL	Qarqafe	القرقية	1185
Mount Lebanon	JUBAIL	Qartaba	قربا	1185
Mount Lebanon	JUBAIL	Qarnaboun	قارنبون	850
Mount Lebanon	JUBAIL	Qas	قاس	970
Mount Lebanon	JUBAIL	Qehmez	قهمز	1100
Mount Lebanon	JUBAIL	Qerfaqous	قرفاقوش	1160
Mount Lebanon	JUBAIL	Qermaya	قربيا	885
Mount Lebanon	JUBAIL	Qerqaiya	قرقايا	975
Mount Lebanon	JUBAIL	Ramout	الراموط	860
Mount Lebanon	JUBAIL	Ras Osta	راس اوستا	1050
Mount Lebanon	JUBAIL	Rihani	الريحانة	850
Mount Lebanon	JUBAIL	Richkol	ريشكول	1100
Mount Lebanon	JUBAIL	Roumieh	رؤمية	850
Mount Lebanon	JUBAIL	Saldet El Qanen	سالدت القانن	1100
Mount Lebanon	JUBAIL	Salib Ghalboun	صليب غلبون	850



RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	JUBAIL	Sajj Rechmaiyia	سجرج شيميا	1165
Mount Lebanon	JUBAIL	Sajqiet el Khaït	ساقية الخيط	940
Mount Lebanon	JUBAIL	Sarifa	ساريفيا	1125
Mount Lebanon	JUBAIL	Sabil	سبيل	960
Mount Lebanon	JUBAIL	Sibrine	سبرين	1000
Mount Lebanon	JUBAIL	Sinnawr	سبنار	850
Mount Lebanon	JUBAIL	Souane	سوانه	1115
Mount Lebanon	JUBAIL	Souq El Ferreh	سوق الفريه	935
Mount Lebanon	JUBAIL	Sourat	سورات	850
Mount Lebanon	JUBAIL	Siran	سيران	850
Mount Lebanon	JUBAIL	Tarjif	تاريف	1150
Mount Lebanon	JUBAIL	Tarwel	تارول	850
Mount Lebanon	JUBAIL	Toudmor	تودمور	1100
Mount Lebanon	JUBAIL	Tourzalya	تورزاليا	1075
Mount Lebanon	JUBAIL	Wata El Ban	وطي البان	850
Mount Lebanon	JUBAIL	Wata El Kalb	وطي الكلب	1095
Mount Lebanon	JUBAIL	Wata Youssef	وطي يوسف	850
Mount Lebanon	JUBAIL	Yanough	يانوغ	1160
Mount Lebanon	JUBAIL	Zandsh	زانج	1000
Mount Lebanon	JUBAIL	Zebdine	زبدين	885
Mount Lebanon	JUBAIL	Zilehmayia	زلهمايا	850
Mount Lebanon	JUBAIL	Zoummar	زوممار	850
Mount Lebanon	JUBAIL	Zoummar	زوممار	1060
Mount Lebanon	KASROUANE	Aabra	العبرة	1025
Mount Lebanon	KASROUANE	Archpout	عشروت	1100
Mount Lebanon	KASROUANE	Ajaljalout	عجلجون	1100
Mount Lebanon	KASROUANE	Aaqelbe	العقة	850
Mount Lebanon	KASROUANE	Aaramoun	عراون	965
Mount Lebanon	KASROUANE	Adma	ادما	850
Mount Lebanon	KASROUANE	Adonis	ادونيس	877
Mount Lebanon	KASROUANE	Ain Ebaail	عين ايبايل	1100
Mount Lebanon	KASROUANE	Ain El Delbe	عين الدلبة	1100
Mount Lebanon	KASROUANE	Ain El Hemblass	عين الحبلاب	1000
Mount Lebanon	KASROUANE	Ain El Jom	عين الجوم	1100
Mount Lebanon	KASROUANE	Ain El Rihahe	عين الريهة	850
Mount Lebanon	KASROUANE	Ain Jwala	عين جوالا	1100
Mount Lebanon	KASROUANE	Ain Warqa	عين ورقة	934
Mount Lebanon	KASROUANE	Aintoura	عنتورة	850
Mount Lebanon	KASROUANE	Alyoun El Simane	عليون السمان	1100
Mount Lebanon	KASROUANE	Bain El Nhour	بين النور	1100
Mount Lebanon	KASROUANE	Balloune	بالونة	925
Mount Lebanon	KASROUANE	Batha	بثا	890
Mount Lebanon	KASROUANE	Beit Eid	بيت عيد	1115
Mount Lebanon	KASROUANE	Beit El Kradli	بيت الكردلي	850
Mount Lebanon	KASROUANE	Beit El Mchidi	بيت مشيد	1100
Mount Lebanon	KASROUANE	Beit Khachbaw	بيت خاشبوا	850
Mount Lebanon	KASROUANE	Biqatet Archpout	بقة عشروت	1100
Mount Lebanon	KASROUANE	Blout El Kraim	بلوت الكرايم	1100
Mount Lebanon	KASROUANE	Blqatet Kannahe	بلقة كمان	1150
Mount Lebanon	KASROUANE	Bizhel	بزلح	850
Mount Lebanon	KASROUANE	Bkrike	بكركي	850
Mount Lebanon	KASROUANE	Bouar	بوار	850
Mount Lebanon	KASROUANE	Bqaoutita	بقة اوتيا	1100
Mount Lebanon	KASROUANE	Bpaq El Din	بفاق الدين	850
Mount Lebanon	KASROUANE	Bzoummar	بوممار	1060
Mount Lebanon	KASROUANE	Chabrouh	شبروح	1100
Mount Lebanon	KASROUANE	Chahtrou	شاحترول	1065
Mount Lebanon	KASROUANE	Chmaasir	شماسير	850
Mount Lebanon	KASROUANE	Chouene	شوان	850
Mount Lebanon	KASROUANE	Chwaia	شوايا	950
Mount Lebanon	KASROUANE	Dafine	دافة	850
Mount Lebanon	KASROUANE	Daraaoun	داراون	875
Mount Lebanon	KASROUANE	Darayia	دارايا	945
Mount Lebanon	KASROUANE	Deir Baqouch	دير بقوش	850
Mount Lebanon	KASROUANE	Deir Bzoummar	دير بوممار	1065
Mount Lebanon	KASROUANE	Deir El Hritq	دير الحريق	1150
Mount Lebanon	KASROUANE	Deir El Kraim	دير الكرايم	900
Mount Lebanon	KASROUANE	Deir Mar Aabda	دير مار عبا	937
Mount Lebanon	KASROUANE	Deir Mar Chalhita Moughes	دير مار شاليتا موقيس	1000
Mount Lebanon	KASROUANE	Deir Mar Doumed (El Bwar)	دير مار شومد (البار)	850
Mount Lebanon	KASROUANE	Deir Mar Doumed (Faitaroun)	دير مار شومد (فايتارون)	1100
Mount Lebanon	KASROUANE	Deir Mar Elias	دير مار ايلياس	850
Mount Lebanon	KASROUANE	Deir Mar Nohra	دير مار نورا	900
Mount Lebanon	KASROUANE	Deir Mar Nqoula	دير مار نوقولا	975
Mount Lebanon	KASROUANE	Deir Mar Rouhana	دير مار روهانا	975
Mount Lebanon	KASROUANE	Deir Mar Roukoz	دير مار روكوز	1010
Mount Lebanon	KASROUANE	Deir El Mkhales	دير المخلس	850
Mount Lebanon	KASROUANE	Deir El Qlameh	دير القلومة	1100
Mount Lebanon	KASROUANE	Deir El Raifoun	دير رايون	1125
Mount Lebanon	KASROUANE	Deir El Roumieh	دير الرومية	1090
Mount Lebanon	KASROUANE	Deir Misbai	دير مسباي	1000
Mount Lebanon	KASROUANE	Deir Saydedet El Boaz	دير سيدية البواز	850
Mount Lebanon	KASROUANE	Deir Saydedet El Hagleh	دير سيدية الحقة	1037
Mount Lebanon	KASROUANE	Deir Saydedet El Hosn	دير سيدية الحصن	1100
Mount Lebanon	KASROUANE	Deir Saydedet El Lwazteb	دير سيدية اللوازبة	850
Mount Lebanon	KASROUANE	Deir Saydedet El Najah	دير سيدية النجاة	975
Mount Lebanon	KASROUANE	Deir Saydedet El Niah	دير سيدية النياح	1100
Mount Lebanon	KASROUANE	Deir Hrach	دير حراش	850
Mount Lebanon	KASROUANE	Deir Khashbaw	دير خاشبوا	850
Mount Lebanon	KASROUANE	Deir Om Allah	دير ام الله	1000
Mount Lebanon	KASROUANE	Delbta	دلثا	935
Mount Lebanon	KASROUANE	Dirail	دير ايلي	1100
Mount Lebanon	KASROUANE	Dqarine	دقارين	850
Mount Lebanon	KASROUANE	El Aafis	العفيس	925
Mount Lebanon	KASROUANE	El Azar	العازر	990
Mount Lebanon	KASROUANE	El Azra	العزرا	1010
Mount Lebanon	KASROUANE	El Azra et el Azr	العزرا والعزر	975
Mount Lebanon	KASROUANE	El Bhairi	البحيري	850
Mount Lebanon	KASROUANE	El Chab	الشعب	850
Mount Lebanon	KASROUANE	El Charfeh	الشرية	975
Mount Lebanon	KASROUANE	El Charwieh	الشروية	1100
Mount Lebanon	KASROUANE	El Harif	الحريف	850
Mount Lebanon	KASROUANE	El Maaden	المدان	987
Mount Lebanon	KASROUANE	El Mesiaf	المصيف	970
Mount Lebanon	KASROUANE	El Mchali	المشالي	1119
Mount Lebanon	KASROUANE	El Mdar	المدار	940
Mount Lebanon	KASROUANE	E Qacha	القاشا	1100
Mount Lebanon	KASROUANE	El Qalaa	القعة	1100
Mount Lebanon	KASROUANE	El Qanater	القاطر	1100
Mount Lebanon	KASROUANE	El Qatine	القطين	990
Mount Lebanon	KASROUANE	El Qmairezeh	القمزرة	850
Mount Lebanon	KASROUANE	El Rihaheh	الريهة	850
Mount Lebanon	KASROUANE	El Salhih	السالحية	850

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	JUBAIL	Sajj Rechmaiyia	سجرج شيميا	1165
Mount Lebanon	JUBAIL	Sajqiet el Khaït	ساقية الخيط	940
Mount Lebanon	JUBAIL	Sarifa	ساريفيا	1125
Mount Lebanon	JUBAIL	Sabil	سبيل	960
Mount Lebanon	JUBAIL	Sibrine	سبرين	1000
Mount Lebanon	JUBAIL	Sinnawr	سبنار	850
Mount Lebanon	JUBAIL	Souane	سوانه	1115
Mount Lebanon	JUBAIL	Souq El Ferreh	سوق الفريه	935
Mount Lebanon	JUBAIL	Sourat	سورات	850
Mount Lebanon	JUBAIL	Siran	سيران	850
Mount Lebanon	JUBAIL	Tarjif	تاريف	1150
Mount Lebanon	JUBAIL	Tarwel	تارول	850
Mount Lebanon	JUBAIL	Toudmor	تودمور	1100
Mount Lebanon	JUBAIL	Tourzalya	تورزاليا	1075
Mount Lebanon	JUBAIL	Wata El Ban	وطي البان	850
Mount Lebanon	JUBAIL	Wata El Kalb	وطي الكلب	1095
Mount Lebanon	JUBAIL	Wata Youssef	وطي يوسف	850
Mount Lebanon	JUBAIL	Yanough	يانوغ	1160
Mount Lebanon	JUBAIL	Zandsh	زانج	1000
Mount Lebanon	JUBAIL	Zebdine	زبدين	885
Mount Lebanon	JUBAIL	Zilehmayia	زلهمايا	850
Mount Lebanon	JUBAIL	Zoummar	زوممار	850
Mount Lebanon	JUBAIL	Zoummar	زوممار	1060
Mount Lebanon	KASROUANE	Aabra	العبرة	1025
Mount Lebanon	KASROUANE	Archpout	عشروت	1100
Mount Lebanon	KASROUANE	Ajaljalout	عجلجون	1100
Mount Lebanon	KASROUANE	Aaqelbe	العقة	850
Mount Lebanon	KASROUANE	Aaramoun	عراون	965
Mount Lebanon	KASROUANE	Adma	ادما	850
Mount Lebanon	KASROUANE	Adonis	ادونيس	877
Mount Lebanon	KASROUANE	Ain Ebaail	عين ايبايل	1100
Mount Lebanon	KASROUANE	Ain El Delbe	عين الدلبة	1100
Mount Lebanon	KASROUANE	Ain El Hemblass	عين الحبلاب	1000
Mount Lebanon	KASROUANE	Ain El Jom	عين الجوم	1100
Mount Lebanon	KASROUANE	Ain El Rihahe	عين الريهة	850
Mount Lebanon	KASROUANE	Ain Jwala	عين جوالا	1100
Mount Lebanon	KASROUANE	Ain Warqa	عين ورقة	934
Mount Lebanon	KASROUANE	Aintoura	عنتورة	850
Mount Lebanon	KASROUANE	Alyoun El Simane	عليون السمان	1100
Mount Lebanon	KASROUANE	Bain El Nhour	بين النور	1100
Mount Lebanon	KASROUANE	Balloune	بالونة	925
Mount Lebanon	KASROUANE	Batha	بثا	890
Mount Lebanon	KASROUANE	Beit Eid	بيت عيد	1115
Mount Lebanon	KASROUANE	Beit El Kradli	بيت الكردلي	850
Mount Lebanon	KASROUANE	Beit El Mchidi	بيت مشيد	1100
Mount Lebanon	KASROUANE	Beit Khachbaw	بيت خاشبوا	850
Mount Lebanon	KASROUANE	Biqatet Archpout	بقة عشروت	1100
Mount Lebanon	KASROUANE	Blout El Kraim	بلوت الكرايم	1100
Mount Lebanon	KASROUANE	Blqatet Kannahe	بلقة كمان	1150
Mount Lebanon	KASROUANE	Bizhel	بزلح	850
Mount Lebanon	KASROUANE	Bkrike	بكركي	850
Mount Lebanon	KASROUANE	Bouar	بوار	850
Mount Lebanon	KASROUANE	Bqaoutita	بقة اوتيا	1100
Mount Lebanon	KASROUANE	Bpaq El Din	بفاق الدين	850
Mount Lebanon	KASROUANE	Bzoummar	بوممار	1060
Mount Lebanon	KASROUANE	Chabrouh	شبروح	1100



RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	KASROUANE	El Slayekh	السلخ	1100
Mount Lebanon	KASROUANE	El Souwaneh	السونة	1190
Mount Lebanon	KASROUANE	El Tallieh	تلة	1100
Mount Lebanon	KASROUANE	El Wsta	الوطني	850
Mount Lebanon	KASROUANE	El Tarouq	التاروق	950
Mount Lebanon	KASROUANE	El Zaitanieh	الزعتانية	850
Mount Lebanon	KASROUANE	Fatroun	فتارون	1070
Mount Lebanon	KASROUANE	Faora	فورا	1100
Mount Lebanon	KASROUANE	Farziya	فازيا	1100
Mount Lebanon	KASROUANE	Fatqa	فاتا	860
Mount Lebanon	KASROUANE	Fraïwan	فرايون	850
Mount Lebanon	KASROUANE	Ghadir	غادير	850
Mount Lebanon	KASROUANE	Ghadras	غدراس	925
Mount Lebanon	KASROUANE	Ghawabi	غواوي	1100
Mount Lebanon	KASROUANE	Ghazir	غزير	850
Mount Lebanon	KASROUANE	Ghaleb	غلبه	1045
Mount Lebanon	KASROUANE	Ghine	غينه	1075
Mount Lebanon	KASROUANE	Ghouchraya	غوشرايا	850
Mount Lebanon	KASROUANE	Ghosta	غوستا	925
Mount Lebanon	KASROUANE	Hadchet	حادثت	975
Mount Lebanon	KASROUANE	Hagdi El Rayets	حط الراس	1100
Mount Lebanon	KASROUANE	Haret el Mir	حارة المير	850
Mount Lebanon	KASROUANE	Haret Sakher	حارة صخر	850
Mount Lebanon	KASROUANE	Harfariya	فراريا	1035
Mount Lebanon	KASROUANE	Harrissa	حريسا	910
Mount Lebanon	KASROUANE	Hay El Manzoul	حي المنزول	850
Mount Lebanon	KASROUANE	Hayata	حياتا	1030
Mount Lebanon	KASROUANE	Haylan	حيلان	900
Mount Lebanon	KASROUANE	Hossain	الحسين	975
Mount Lebanon	KASROUANE	Hirajel	حراجيل	1100
Mount Lebanon	KASROUANE	Ighbeh El Tahra	اغية القتا	1125
Mount Lebanon	KASROUANE	Ighbeh El Fawqa	اغية فوقا	1100
Mount Lebanon	KASROUANE	Jabal Mousa	جبل موسى	1100
Mount Lebanon	KASROUANE	Jazair	جزائر	850
Mount Lebanon	KASROUANE	Joidet Ghazir	جويدت غزير	870
Mount Lebanon	KASROUANE	Jitta	جيتا	850
Mount Lebanon	KASROUANE	Jounie	جونيه	850
Mount Lebanon	KASROUANE	Jouret Bedrane	جوريت بدرانه	1030
Mount Lebanon	KASROUANE	Jouret Et Tormoss	جوريت الترمس	1105
Mount Lebanon	KASROUANE	Jouret Mghad	جوريت مهاد	1170
Mount Lebanon	KASROUANE	Jwar El Bwacheq	جوار البواحق	1165
Mount Lebanon	KASROUANE	Jwar El Hechich	جوار الحشيش	1185
Mount Lebanon	KASROUANE	Kaslik	كاسليك	850
Mount Lebanon	KASROUANE	Kfar Aaos	كفر عوس	950
Mount Lebanon	KASROUANE	Kfar Chham	كفر شحم	850
Mount Lebanon	KASROUANE	Kfar Debban	كفر ديبان	1100
Mount Lebanon	KASROUANE	Kfar Hibab	كفر حباب	850
Mount Lebanon	KASROUANE	Kfar Inif	كفر انيف	850
Mount Lebanon	KASROUANE	Kfarfai	كفرفاي	1100
Mount Lebanon	KASROUANE	Kiaryassine	كيارياسين	850
Mount Lebanon	KASROUANE	Kfour	كفور	1015
Mount Lebanon	KASROUANE	Khayeb Nahr Ibrahim	خرايب نهر ابراهيم	850
Mount Lebanon	KASROUANE	Maameltine	الماعتين	850
Mount Lebanon	KASROUANE	Maarab	معارب	981
Mount Lebanon	KASROUANE	Mairouba	ميروبا	1100
Mount Lebanon	KASROUANE	Maissra	المعصرة	925

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	KASROUANE	Mar Edna	مار ايدنا	850
Mount Lebanon	KASROUANE	Mar Youhana	مار يوحنا	850
Mount Lebanon	KASROUANE	Maraat Kfardikiane	مزارع كفر ديكيان	1100
Mount Lebanon	KASROUANE	Maraat El Boustan	مزارع البستان	925
Mount Lebanon	KASROUANE	Maraat El kherbeh	مزارع الخربة	850
Mount Lebanon	KASROUANE	Maraat El Mraijeh	مزارع المرية	1100
Mount Lebanon	KASROUANE	Maraat El Ras	مزارع الراس	850
Mount Lebanon	KASROUANE	Maraat Sabrine	مزارع سابرين	1190
Mount Lebanon	KASROUANE	Mehgan El Mazloum	مطغان المظلوم	1100
Mount Lebanon	KASROUANE	Mghayer	المغايير	1100
Mount Lebanon	KASROUANE	Mhalbet	مخبيت	850
Mount Lebanon	KASROUANE	Mradfiye	المردفية	990
Mount Lebanon	KASROUANE	Mraih El Mir	مرايح المير	1045
Mount Lebanon	KASROUANE	Nabaa El Assal	نابح الصل	1100
Mount Lebanon	KASROUANE	Nabaa El Hadid	نابح الحديد	1100
Mount Lebanon	KASROUANE	Nabaa El Khaira	نابح الخيرة	850
Mount Lebanon	KASROUANE	Nabaa El Laban	نابح اللبن	1100
Mount Lebanon	KASROUANE	Nabaa El Mghara	نابح المغارة	1100
Mount Lebanon	KASROUANE	Nabaa Jaitha	نابح جيثا	850
Mount Lebanon	KASROUANE	Nahr El Dhab	نهر الداب	1040
Mount Lebanon	KASROUANE	Nahr El Kaleb	نهر الكلب	850
Mount Lebanon	KASROUANE	Nimoura	المعرة	1005
Mount Lebanon	KASROUANE	Ouata El Jauz	وهي الجوز	1100
Mount Lebanon	KASROUANE	Quata Slam	واقي سلام	850
Mount Lebanon	KASROUANE	Qarsa	قرسا	925
Mount Lebanon	KASROUANE	Qlaizat	قلعيات	1125
Mount Lebanon	KASROUANE	Qouwaléh	قوة	850
Mount Lebanon	KASROUANE	Rachine	راطين	1100
Mount Lebanon	KASROUANE	Ram Bou Daqen	رام بوقدن	990
Mount Lebanon	KASROUANE	Rayfoun	راي فون	1125
Mount Lebanon	KASROUANE	Safa	الصفا	850
Mount Lebanon	KASROUANE	Sahel Aalima	ساحل اعلى	850
Mount Lebanon	KASROUANE	Sarba	ساربا	850
Mount Lebanon	KASROUANE	Saldet El Nchif	سيدة النيف	975
Mount Lebanon	KASROUANE	Saldet El Qalaa	سيدة القلعة	1188
Mount Lebanon	KASROUANE	Sinawr	سوار	1100
Mount Lebanon	KASROUANE	Shail	شيلة	885
Mount Lebanon	KASROUANE	Snowbar	سناوبار	970
Mount Lebanon	KASROUANE	Tabarja	طبرجا	850
Mount Lebanon	KASROUANE	Tabrieh	طبرية	1100
Mount Lebanon	KASROUANE	Wadi Tali	وادي تالي	850
Mount Lebanon	KASROUANE	Yaikchouch	يايخوش	935
Mount Lebanon	KASROUANE	Zaitira	زيتيرة	975
Mount Lebanon	KASROUANE	Zeltoun	زلتون	890
Mount Lebanon	KASROUANE	Zouk Mosbeh	زوك موشبع	880
Mount Lebanon	KASROUANE	Zouq Mikayel	زوق ميكائيل	850
Nabatieh	BENT JUBAIL	Ainama	عيناتا	775
Nabatieh	BENT JUBAIL	Aita ez Zott	عينا الزوط	745
Nabatieh	BENT JUBAIL	Aaitaroun	عيتارون	730
Nabatieh	BENT JUBAIL	Ain Ebel	عين ايل	655
Nabatieh	BENT JUBAIL	Aita Ech Chaab	عينا الشب	730
Nabatieh	BENT JUBAIL	Aita El Jabal	عينا الجبل	745
Nabatieh	BENT JUBAIL	Belt Luf	بيلت ليف	670
Nabatieh	BENT JUBAIL	Belt Yahnoun	بيلت يانون	805
Nabatieh	BENT JUBAIL	Bent Jbail	بنت جبيل	790
Nabatieh	BENT JUBAIL	Bir El Samasel	بير الساسيل	725
Nabatieh	BENT JUBAIL	Bonj Qalbeoufye	بورج القوبه	655



RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Nabatieh	BENT JUBAIL	Braachit	بزرعيت	755
Nabatieh	BENT JUBAIL	Chaqra	شقرّا	715
Nabatieh	BENT JUBAIL	Debel	ديبل	695
Nabatieh	BENT JUBAIL	Deir Nfar	دير النفر	680
Nabatieh	BENT JUBAIL	El Habis	الحبيب	780
Nabatieh	BENT JUBAIL	El Qalaa	القلاعة	740
Nabatieh	BENT JUBAIL	El Soufaniyeh	السفانية	705
Nabatieh	BENT JUBAIL	Ghandouziyeh	غندورية	655
Nabatieh	BENT JUBAIL	Haddata	حداتا	785
Nabatieh	BENT JUBAIL	Hamine	حمّان	740
Nabatieh	BENT JUBAIL	Haris	حارصن	765
Nabatieh	BENT JUBAIL	Jabal Aamel	جبل اعامل	786
Nabatieh	BENT JUBAIL	Joab el Arab	جواب العرب	715
Nabatieh	BENT JUBAIL	Jimajime	جيمجمة	750
Nabatieh	BENT JUBAIL	Katra	كفرا	775
Nabatieh	BENT JUBAIL	Kfar Dourine	كفر دوقين	695
Nabatieh	BENT JUBAIL	Khribt Immiyeh	خربة ايمية	712
Nabatieh	BENT JUBAIL	Khribt Slim	خربة سلم	720
Nabatieh	BENT JUBAIL	Kounine	كونين	760
Nabatieh	BENT JUBAIL	Maroun er Ras	مارون الراص	865
Nabatieh	BENT JUBAIL	Mazraat Froun	مزرعة فرون	765
Nabatieh	BENT JUBAIL	Qalaaouiyeh	قلاعة	655
Nabatieh	BENT JUBAIL	Qatroun	القطنون	685
Nabatieh	BENT JUBAIL	Qouzah	قوزاح	770
Nabatieh	BENT JUBAIL	Rachaf	رشاف	735
Nabatieh	BENT JUBAIL	Ramiye	رامية	695
Nabatieh	BENT JUBAIL	Rimalich	ريميل	690
Nabatieh	BENT JUBAIL	Safad el Battikh	صفاة البتخ	745
Nabatieh	BENT JUBAIL	Sailhani	سالحاني	720
Nabatieh	BENT JUBAIL	Sammoukha	سموكها	740
Nabatieh	BENT JUBAIL	Sribbine	سربين	700
Nabatieh	BENT JUBAIL	Taire	التوري	780
Nabatieh	BENT JUBAIL	Tebnine	تبنين	740
Nabatieh	BENT JUBAIL	Yaroun	يارون	780
Nabatieh	BENT JUBAIL	Yater	ياتر	760
Nabatieh	HASBAYA	Abou Qamha	ابو قامة	685
Nabatieh	HASBAYA	Ain El Mantaneh	عين المشنة	755
Nabatieh	HASBAYA	Ain Fjour	عين فجور	835
Nabatieh	HASBAYA	Ain Jerfa	عين جرفا	780
Nabatieh	HASBAYA	Ain Qemya	عين قيميا	885
Nabatieh	HASBAYA	Ain Tinta	عين تانتا	850
Nabatieh	HASBAYA	Beit Iseber	بيت ايسبر	805
Nabatieh	HASBAYA	Beit Nawfal	بيت نوافل	830
Nabatieh	HASBAYA	Beit Samieh	بيت ساميه	772
Nabatieh	HASBAYA	Berg'hoz	بئر حوز	660
Nabatieh	HASBAYA	Chebaa	شعبا	1100
Nabatieh	HASBAYA	Chouala	شوايا	940
Nabatieh	HASBAYA	Dnaibe	دنايبه	815
Nabatieh	HASBAYA	El Aabasieh	العابسيه	655
Nabatieh	HASBAYA	El Dhairjat	الذيرجات	655
Nabatieh	HASBAYA	El Ghajar	الغجر	655
Nabatieh	HASBAYA	El Khalwat	الخوات	880
Nabatieh	HASBAYA	Fachkoul	فحكول	705
Nabatieh	HASBAYA	Fardis	الفرديس	690
Nabatieh	HASBAYA	Halita	حلا	755
Nabatieh	HASBAYA	Hasbaya	حاصبيا	780

Nabatieh	HASBAYA	Hetbariyeh	الهتباريه	780
Nabatieh	HASBAYA	Isamiyeh	اساميه	655
Nabatieh	HASBAYA	Jfsr El Hasbani	جسر الحاصباني	680
Nabatieh	HASBAYA	Kaoukaba	كوكبا	735
Nabatieh	HASBAYA	Kfair	الكفير	855
Nabatieh	HASBAYA	Kfar Chouba	كفر شوبا	1100
Nabatieh	HASBAYA	Kfar Hamam	كفر حمام	805
Nabatieh	HASBAYA	Khalit El Ghazala	حلا الغزاة	705
Nabatieh	HASBAYA	Khalwat EL Biryada	خوات البرياده	860
Nabatieh	HASBAYA	Khawit Jbil	خوات جبلي	805
Nabatieh	HASBAYA	Khribt El Dweir	خربة الدوير	655
Nabatieh	HASBAYA	Khribt EL Hadat	خربة الحدت	755
Nabatieh	HASBAYA	Khralbe	الكرايبه	685
Nabatieh	HASBAYA	Majidiye	المجيديه	655
Nabatieh	HASBAYA	Mari	الماري	665
Nabatieh	HASBAYA	Mari ez Zouhour (Istabl)	مزرع الزهور	820
Nabatieh	HASBAYA	Mazraat Brahtha	مزرعة براهثا	1100
Nabatieh	HASBAYA	Mazraat Qafwa	مزرعة قفوا	805
Nabatieh	HASBAYA	Mimes	ميمس	805
Nabatieh	HASBAYA	Moghtr Chebaa	مغر شعبا	655
Nabatieh	HASBAYA	Mrah EL Bireh	مراع البيره	1100
Nabatieh	HASBAYA	Mrah Sabya	مراع صبيا	980
Nabatieh	HASBAYA	Nabaa EL Jawz	نابع الجوز	1100
Nabatieh	HASBAYA	Nabaa El Mghara	نابع المغارة	955
Nabatieh	HASBAYA	Nkhaille	نخايله	655
Nabatieh	HASBAYA	Nkhaille	نخايله	655
Nabatieh	HASBAYA	Rachaya el Foukhar	راشيا الفوخار	780
Nabatieh	HASBAYA	Ramta	رامتا	1100
Nabatieh	HASBAYA	Ras Balidar	راس بالدار	685
Nabatieh	HASBAYA	Sfirneh	سفينه	805
Nabatieh	HASBAYA	Slayib	سلايب	655
Nabatieh	HASBAYA	Souq El Khan	سوق الخان	705
Nabatieh	HASBAYA	Zighleh	زغله	780
Nabatieh	MARIAYOUN	Aadaisse	عابسيه	755
Nabatieh	MARIAYOUN	Aadchit el Qalir	عاشيت القصر	655
Nabatieh	MARIAYOUN	Aalmane	اطمان	655
Nabatieh	MARIAYOUN	Aarab El Loualzeh	عرب الازبه	655
Nabatieh	MARIAYOUN	Aarab	عربا	655
Nabatieh	MARIAYOUN	Bahyouda	بازيوسه	680
Nabatieh	MARIAYOUN	Bani Haiyane	بني حايونه	835
Nabatieh	MARIAYOUN	Bani Awarida	بني حيران	657
Nabatieh	MARIAYOUN	Blat	بلاط	745
Nabatieh	MARIAYOUN	Blida	بليا	720
Nabatieh	MARIAYOUN	Bonj El Moulouk	بوج الملوك	717
Nabatieh	MARIAYOUN	Deir Mimmas	دير ميماس	695
Nabatieh	MARIAYOUN	Deir Sentiane	دير سريان	667
Nabatieh	MARIAYOUN	Dibbine	ديبين	790
Nabatieh	MARIAYOUN	Doubieh	دوبيه	655
Nabatieh	MARIAYOUN	El Deir	الدير	717
Nabatieh	MARIAYOUN	El Wazani	الوازي	655
Nabatieh	MARIAYOUN	Houla	حولا	785
Nabatieh	MARIAYOUN	Houra	هورا	655
Nabatieh	MARIAYOUN	Ibl es Saqi	ابل السقي	785
Nabatieh	MARIAYOUN	Jaidir Marjayoun	جيدية مارجون	805
Nabatieh	MARIAYOUN	Jiser El Khardale	جسر الكرادله	655
Nabatieh	MARIAYOUN	Jlil El Gheidan	جليل الغيدان	680

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Nabatieh	MARIAYOUN	Kfar Kila	كفر كلا	655
Nabatieh	MARIAYOUN	Khiyam	الخيما	752
Nabatieh	MARIAYOUN	Khirbe	خربة	717
Nabatieh	MARIAYOUN	Maisat	ميسات	655
Nabatieh	MARIAYOUN	Majdel Sillim	مجدل سيلم	685
Nabatieh	MARIAYOUN	Mariayoun	مريجون	770
Nabatieh	MARIAYOUN	Markaba	مركا	755
Nabatieh	MARIAYOUN	Mazraat El Jouleinih	مزرعة الجولينية	730
Nabatieh	MARIAYOUN	Mazraat El Jralin	مزرعة الجرالين	717
Nabatieh	MARIAYOUN	Mazaat EL Sahshahiyeh	مزرعة المسحوية	725
Nabatieh	MARIAYOUN	Meiss ej Jabal	ميس الجبل	720
Nabatieh	MARIAYOUN	Mhailib	مخيب	740
Nabatieh	MARIAYOUN	Nabaa El Dardara	نبع الدار	667
Nabatieh	MARIAYOUN	Nabaa El Houjaïr	نبع الحويجر	695
Nabatieh	MARIAYOUN	Nabi Youchaa	نبي يوحنا	705
Nabatieh	MARIAYOUN	Qabnkh	قربنا	655
Nabatieh	MARIAYOUN	Qalaa Doubieh	قلعة دوبيه	745
Nabatieh	MARIAYOUN	Qalaa Selloum	قلعة سلوم	755
Nabatieh	MARIAYOUN	Qantara	قنطرة	655
Nabatieh	MARIAYOUN	Qlalaia	قلعة	735
Nabatieh	MARIAYOUN	Qsair	القصير	655
Nabatieh	MARIAYOUN	Rabb et Talatine	رب التالين	715
Nabatieh	MARIAYOUN	Sarda	سارده	655
Nabatieh	MARIAYOUN	Souane	سوانة	675
Nabatieh	MARIAYOUN	Taibe	طيبة	735
Nabatieh	MARIAYOUN	Tallouse	طلاوس	665
Nabatieh	MARIAYOUN	Tammieh	طمرية	677
Nabatieh	MARIAYOUN	Touline	طولين	655
Nabatieh	MARIAYOUN	Wadi El Skouki	وادي السوكي	655
Nabatieh	MARIAYOUN	Ziqieh	زقيا	655
Nabatieh	MARIAYOUN	Zabba	عبا	655
Nabatieh	MARIAYOUN	Adachit ech Chqif	عديت الشقيف	655
Nabatieh	MARIAYOUN	Aarmoun	ارمون	700
Nabatieh	MARIAYOUN	Aazze	عزة	655
Nabatieh	MARIAYOUN	Ain Bou Souar	عين بوسوار	880
Nabatieh	MARIAYOUN	Ain Qana	عين قنا	745
Nabatieh	MARIAYOUN	Arab Salim	عرب صليم	685
Nabatieh	MARIAYOUN	Bifaroua	بفاره	655
Nabatieh	MARIAYOUN	Braiqaa	بريق	655
Nabatieh	MARIAYOUN	Charayye	الشراية	655
Nabatieh	MARIAYOUN	Choukine	شوكين	675
Nabatieh	MARIAYOUN	Deir ez Zahrani	دير الزهراني	655
Nabatieh	MARIAYOUN	Deir Msr Antonilos	دير مسر انتونيلوس	655
Nabatieh	MARIAYOUN	Douqar	الدوقر	655
Nabatieh	MARIAYOUN	El Jawharieh	الجوارية	655
Nabatieh	MARIAYOUN	El Manzaleh	المنزلة	655
Nabatieh	MARIAYOUN	Fadoullieh	فادولية	655
Nabatieh	MARIAYOUN	Ghabarine	غبارين	655
Nabatieh	MARIAYOUN	Habbouch	حوش	655
Nabatieh	MARIAYOUN	Hamra	الحمرا	655
Nabatieh	MARIAYOUN	Harouf	حاروف	655
Nabatieh	MARIAYOUN	Hima Aarmoun	حما ارمون	670
Nabatieh	MARIAYOUN	Hmalieh	الحمية	655
Nabatieh	MARIAYOUN	Houmine el Faouqa	حومين فوقا	680
Nabatieh	MARIAYOUN	Houmine et Tahha	حومين التاحا	655
Nabatieh	MARIAYOUN	Insar	انسار	655

Nabatieh	NABATIEH	Jarijouaa	جرجوج	825
Nabatieh	NABATIEH	Jbaa	جباا الحباري	790
Nabatieh	NABATIEH	Jibchit	جبشيت	655
Nabatieh	NABATIEH	Kafra	كفرا	730
Nabatieh	NABATIEH	Kfar Dejjal	كفر دجلال	655
Nabatieh	NABATIEH	Kfar Fila	كفر فيلا	660
Nabatieh	NABATIEH	Kfar Roummane	كفر رومان	655
Nabatieh	NABATIEH	Kfar Sir	كفر صير	655
Nabatieh	NABATIEH	Kfar Tebnit	كفر تبنيت	655
Nabatieh	NABATIEH	Kfour	القفور	655
Nabatieh	NABATIEH	Ksar Zaatar	كسار زعتر	655
Nabatieh	NABATIEH	Maifadoun	ميفدون	655
Nabatieh	NABATIEH	Marsam Ali El Taher	مقس على الطاهر	690
Nabatieh	NABATIEH	Mazraat Bsafour	مزرعة بسفور	655
Nabatieh	NABATIEH	Mazraat Chelbael	مزرعة شبلع	655
Nabatieh	NABATIEH	Mazraat Dmoul	مزرعة دمول	655
Nabatieh	NABATIEH	Mazraat el Bayada	مزرعة البيضا	655
Nabatieh	NABATIEH	Mazraat El Kfiribeh	مزرعة الكفيرة	655
Nabatieh	NABATIEH	Mazraat Kfar el Jouz	مزرعة كفر جوز	655
Nabatieh	NABATIEH	Mazraat Maiaseh	مزرعة مياسه	805
Nabatieh	NABATIEH	Mgharet Chqif	مغارة الشقيف	655
Nabatieh	NABATIEH	Mrah El Qabbou	مراح القور	655
Nabatieh	NABATIEH	Nabatiye	نابية	655
Nabatieh	NABATIEH	Nabatiye el Faouqa	نابية فوقا	655
Nabatieh	NABATIEH	Nabatiye el Tahia	نابية التاحا	655
Nabatieh	NABATIEH	Nmaiyeh	نماية	655
Nabatieh	NABATIEH	Qasqaat ej Jisr	قاسقات الجسر	655
Nabatieh	NABATIEH	Qalaa El Chqif	قلعة الشقيف	762
Nabatieh	NABATIEH	Qs-aihe	القسية	655
Nabatieh	NABATIEH	Roumine	رومين	655
Nabatieh	NABATIEH	Rwais El Kharoub	رويس الخروب	655
Nabatieh	NABATIEH	Sarba	ساربا	690
Nabatieh	NABATIEH	Selousine Sir	سلوان سير	655
Nabatieh	NABATIEH	Sini	سني	655
Nabatieh	NABATIEH	Sir el Gharbiye	سير الغربية	655
Nabatieh	NABATIEH	Tal El Zatar	تل الزعتر	655
Nabatieh	NABATIEH	Toul	تول	655
Nabatieh	NABATIEH	Yohmor	يخمر	670
Nabatieh	NABATIEH	Zaouita ech Charqiye	زاوية الشراية	655
Nabatieh	NABATIEH	Zaouitar el Gharbiye	زاوية الغربية	655
Nabatieh	NABATIEH	Zebdine	زبدن	655
Nabatieh	NABATIEH	Zefia	زفا	655
North	AKKAR	Aabboudiye	العوبية	745
North	AKKAR	Aadbel	عادل	745
North	AKKAR	Aalimoun	عيلمون	887
North	AKKAR	Aaliyat	عاليات	835
North	AKKAR	Aaklar El Atriqa	عكاز العتية	905
North	AKKAR	Armeiret el Bikat	عزاز البيكات	745
North	AKKAR	Amniye	العمانية	745
North	AKKAR	Aandjot	عندجات	805
North	AKKAR	Asouinat	غابات	745
North	AKKAR	Aarab Joumna	عرب جومنا	783
North	AKKAR	Aradi El Soud	الراضي السود	745
North	AKKAR	Arme	الارمية	745
North	AKKAR	Aarida	عريضة	745
North	AKKAR	Aarqa	عرقا	745
North	AKKAR	Aayoun	العون	780



RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

North	AKKAR	Cheikh Zernad	الشجر زائد	745
North	AKKAR	Cheikhlar	شخيلار	745
North	AKKAR	Chittaha	الشحانة	755
North	AKKAR	Dabadeb	داباب	745
North	AKKAR	Dababbiye el Cahngiyeh	دابابية القريفة	745
North	AKKAR	Dababbiye el Gharbie	دابابية الغربية	745
North	AKKAR	Daaghe	الداغي	745
North	AKKAR	Dahr Aaliyas	شاهر عوامن	745
North	AKKAR	Dahr Billa	شاهر بلا	745
North	AKKAR	Dahr El Bellan	شاهر بلان	845
North	AKKAR	Dahr El Housain	شاهر الحسين	745
North	AKKAR	Dahr El Kniseh	شاهر الكنيسة	745
North	AKKAR	Dahr El Qambar	شاهر القنبر	745
North	AKKAR	Dahr Laisineh	شاهر لاسينية	745
North	AKKAR	Dahra	الداهرا	745
North	AKKAR	Dambo	دلمو	810
North	AKKAR	Danke	دانكة	745
North	AKKAR	Dacoura	دائرة	785
North	AKKAR	Daousse et Baghdadi	دؤسة	745
North	AKKAR	Dar Ain El Awra	دار عين العورا	745
North	AKKAR	Dar Chwita	دار شويتا	795
North	AKKAR	Darine	دارين	745
North	AKKAR	Deir Dalloum	دير تلوم	745
North	AKKAR	Deir Jaminh	دير جامن	745
North	AKKAR	Deir Mar Elias	دير مار إلياس	745
North	AKKAR	Deir Mar Jerjos	دير مار جرجوس	745
North	AKKAR	Deir Mar moura	دير مار مورا	745
North	AKKAR	Deir Saidet El Qalaa	دير سيدة القلعة	745
North	AKKAR	Dibebbet El Charqieh	دابابية الشرقية	745
North	AKKAR	Dihir	ديهر	765
North	AKKAR	Doueir Aaboujye	دؤير عابوية	745
North	AKKAR	El Aabde	العابدة	745
North	AKKAR	El Aawadeh	العوادة	745
North	AKKAR	El Aawarichat	العوارشات	745
North	AKKAR	El Aawalineh	العواليه	995
North	AKKAR	El Aahr	العهر	745
North	AKKAR	El Aalalqa	العالية	970
North	AKKAR	El Amaira	العمايرة	745
North	AKKAR	El Amayer	العماير	745
North	AKKAR	El Anrida	العوريدة	745
North	AKKAR	El Bqaiasa	القبيسة	745
North	AKKAR	El Hicheh	الهبشة	745
North	AKKAR	El Hamra	الحمررا	745
North	AKKAR	El Hawch	العورح	745
North	AKKAR	El Hehr	العهر	745
North	AKKAR	El Hmalira	الحمريرة	1045
North	AKKAR	El Housaina	الحوسينية	745
North	AKKAR	El Khalisa	الخالسة	745
North	AKKAR	El Khan	الخان	745
North	AKKAR	El Khirbeh	الخرية	745
North	AKKAR	El Kharmoubeh	الخرموية	745
North	AKKAR	El Khoof	الخرور	770
North	AKKAR	El Krahneh	الكرانية	745
North	AKKAR	El Kroum	الكروم	745
North	AKKAR	El Maimoudia	المخمودية	745
North	AKKAR	El Maimra	المخمرة	745

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
North	AKKAR	Aayoun El Ghezlaane	عين العولان	745
North	AKKAR	Ain Aarous	عين عروس	775
North	AKKAR	Ain Achma	عين الشما	745
North	AKKAR	Ain El Hameim	عين الحمام	745
North	AKKAR	Ain El Qabou	عين القبو	845
North	AKKAR	Ain El Resas	عين الرصاص	745
North	AKKAR	Ain El Wardeh	عين الوردة	1100
North	AKKAR	Ain El Zait	عين الزايتونة	745
North	AKKAR	Ain Tarita	عين تارتا	745
North	AKKAR	Ain Yaqqoub	عين ياقوب	840
North	AKKAR	Alkroum	الكروم	935
North	AKKAR	Badouaa	بدرج	745
North	AKKAR	Baghdadi	بغادي	745
North	AKKAR	Bajaa	بجعا	745
North	AKKAR	Balide	بالدة	745
North	AKKAR	Barcha	برشا	745
North	AKKAR	Barde	الباردة	745
North	AKKAR	Bebine	ببيني	745
North	AKKAR	Beimo	ببمو	755
North	AKKAR	Beit Ayoub	بيت ايوب	1020
North	AKKAR	Beit Daoud	بيت داود	790
North	AKKAR	Beit El Gharib	بيت الغريب	870
North	AKKAR	Beit el Ghattas	بيت عطاش	745
North	AKKAR	Beit el Haj	بيت الحاج	745
North	AKKAR	Beit El Ihalil	بيت الهليل	895
North	AKKAR	Beit El Zahleh	بيت الزايلة	785
North	AKKAR	Beit Haouch	بيت الحوش	745
North	AKKAR	Beit Jaalouk	بيت جالوك	745
North	AKKAR	Beit Mellat	بيت ملات	765
North	AKKAR	Beit Quehebe	بيت قوهبه	745
North	AKKAR	Beit Younes	بيت يونس	970
North	AKKAR	Barbara	بربارة	745
North	AKKAR	Berqayel	برقائل	745
North	AKKAR	Bezbina	بزبينا	825
North	AKKAR	Bire	البيرة	760
North	AKKAR	Borj	البرج	790
North	AKKAR	Borj El Asrab	برج العراب	745
North	AKKAR	Bqerzala	بقرزلا	745
North	AKKAR	Braghit	براغيت	745
North	AKKAR	Bzaita	بزيتا	745
North	AKKAR	Bzal	بزال	745
North	AKKAR	Chaab Webel	شعب وابل	975
North	AKKAR	Chadra	شادرا	745
North	AKKAR	Chambouq	شموق	1090
North	AKKAR	Chane	شان	810
North	AKKAR	Chaodouf	الشحرف	805
North	AKKAR	Chaodouf Askhar	شحرف عسكار	970
North	AKKAR	Charbilla	شربلا	745
North	AKKAR	Charifeh	شرفية	795
North	AKKAR	Cheikh Mohammad	الشيخ محمد	745
North	AKKAR	Cheikh Aayach	الشيخ عياش	745
North	AKKAR	Cheikh Hmalirine	شاهر حماليرين	745
North	AKKAR	Cheikh Ismail	الشيخ اسماعيل	810
North	AKKAR	Cheikh Mearouf	الشيخ معروف	745
North	AKKAR	Cheikh Mhamdeh	الشيخ مهيده	745
North	AKKAR	Cheikh Tabb	الشيخ طبا	745

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
North	AKKAR	El Majdel	المجدل	745
North	AKKAR	El Masla	المسلا	745
North	AKKAR	El Mbarakieh	المباركية	745
North	AKKAR	El Mchaeliha	المشعلية	745
North	AKKAR	El Meghraq	المغراق	745
North	AKKAR	El Mouwachchi	المواشحي	745
North	AKKAR	El Mouwachchi	المواشحي	870
North	AKKAR	El Mouwseih	الموسيه	770
North	AKKAR	El Mozalemeih	الموزاليميه	745
North	AKKAR	El Nabi Osman	النبي عثمان	795
North	AKKAR	El Nsour	النسور	745
North	AKKAR	El Qjaizat	القيجات	745
North	AKKAR	El Rameih	الراميه	745
North	AKKAR	El Ransia	الرانسية	745
North	AKKAR	El Rwalimeh	الرزيميه	1100
North	AKKAR	El Rweis	الرويس	770
North	AKKAR	El Saïd	السيد	745
North	AKKAR	El Samounieh	السمونية	745
North	AKKAR	El Sawalifa	السواليفيه	745
North	AKKAR	El Tlaïl	التلايل	745
North	AKKAR	El Zereh	الزوره	745
North	AKKAR	El Zouq	الزوق	745
North	AKKAR	El Zwalitini	الزوايتيني	745
North	AKKAR	Fnaïdek	الفناديك	1070
North	AKKAR	Fraïdis	فرايدس	745
North	AKKAR	Fsiqine et Ain Echma	فسيقين و عين عشمه	745
North	AKKAR	Ghwaïa	غوايا	800
North	AKKAR	Ghazaleïh	غزازليه	745
North	AKKAR	Habchit	حابشيت	785
North	AKKAR	Haritla	هاريتلا	745
North	AKKAR	Harzouq	حارزوق	745
North	AKKAR	Hakour	الحكور	745
North	AKKAR	Halba	حلبا	745
North	AKKAR	Hasouchah	حوشب	745
North	AKKAR	Harret El Jaldieh	حرة الجدييه	745
North	AKKAR	Harf Bteana	حرف بئنا	805
North	AKKAR	Harf El Sim	حرف السيم	745
North	AKKAR	Hawchab	حوشب	745
North	AKKAR	Heddi	هددي	745
North	AKKAR	Hekr El Cheïkh Taba	حكر الشيخ طبا	745
North	AKKAR	Hekr El Dahri	حكر الداهري	745
North	AKKAR	Hekr El Koussb	حكر الكوسب	745
North	AKKAR	Hekr Jamine	حكر جامين	745
North	AKKAR	Hissa	حيسا	745
North	AKKAR	Hmalis	حماليس	745
North	AKKAR	Hnalider	حناليدر	765
North	AKKAR	Houaïch	حوايش	745
North	AKKAR	Hrar	حراي	935
North	AKKAR	Ilal	لايلت	745
North	AKKAR	Jabal Akroum	جبل اكروم	1038
North	AKKAR	Janin	جانين	745
North	AKKAR	Jaldie	الجدييه	745
North	AKKAR	Jaldiet El Joumeïh	جدييه الجومه	745
North	AKKAR	Jaldiet El Qaitrea	جدييه القايتره	745
North	AKKAR	Jebraïel	جبرايل	745
North	AKKAR	Jwar El Aarab	جوار العرب	745

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
North	AKKAR	Karm Aafour	كرم عصفور	745
North	AKKAR	Karm Zebolin	كرم زبولين	780
North	AKKAR	Kfar El Frouh	كفر الفروح	765
North	AKKAR	Kfar Harra	كفر حرة	745
North	AKKAR	Kfar Meïki	كفر ملكه	745
North	AKKAR	Kfar Moun	كفر مون	745
North	AKKAR	Kfar Toun	كفرتون	940
North	AKKAR	Khain	خان	745
North	AKKAR	Khirbit Ain Tibo	خربة عين طيبو	825
North	AKKAR	Khirbet Char	خربة شار	745
North	AKKAR	Khirbet Daoud	خربة داود	765
North	AKKAR	Khirbit El Jord	خربة الجرد	900
North	AKKAR	Khirbit El Rimman	خربة الرمان	745
North	AKKAR	Khoja Boustain	خوجا بستان	745
North	AKKAR	Khoucha	خوشا	745
North	AKKAR	Khrabot ej Joundi	خربة الجندي	745
North	AKKAR	Kraïseh	كرايسه	765
North	AKKAR	Kraïsse	الكرايسه	745
North	AKKAR	Kouachra	لكنوشرة	745
North	AKKAR	Koucha	كوشا	745
North	AKKAR	Kouwaïkhat	كوايكات	745
North	AKKAR	Kroum el Arab	كروم عرب	745
North	AKKAR	Machha	مشحا	745
North	AKKAR	Machta Hammoud	مشح حמוד	745
North	AKKAR	Machta Hassan	مشح حسن	745
North	AKKAR	Mahmoudiet El Hiteïr	محمودية الحكر	745
North	AKKAR	Majdel	مجدل	795
North	AKKAR	Majdia	مجدلا	745
North	AKKAR	Maïklye	مايكليه	745
North	AKKAR	Mar Challita	مار شليلتا	845
North	AKKAR	Mar Edna	مار ايدنا	745
North	AKKAR	Mar Elias	مار إلياس	845
North	AKKAR	Mar Sarkis	مار سركيس	770
North	AKKAR	Mar Touma	مار توما	745
North	AKKAR	Marïayeh	مارلايه	995
North	AKKAR	Marayret Habbara	مارلايه حبارة	745
North	AKKAR	Maretmoura	مارتلورة	795
North	AKKAR	Masla	المسلا	745
North	AKKAR	Massaoudiye	المساونيه	745
North	AKKAR	Marraat Baldeh	مزرعة بئنا	745
North	AKKAR	Marraat El Nahriye	مزرعة النهرية	745
North	AKKAR	Mechmech	مشحن	1025
North	AKKAR	Meghraq	مغراق	745
North	AKKAR	Menjez	منجل	745
North	AKKAR	Misiane	ميدان	795
North	AKKAR	Mimneaa	مننج	970
North	AKKAR	Mityara	ميتارة	745
North	AKKAR	Mouqem El Cheïth Zïmad	مقام الشيخ زئد	745
North	AKKAR	Mqabile	مقابلة	745
North	AKKAR	Mqaitaa	مقايطة	885
North	AKKAR	Mrah El Aïnouneh	مراح العيونيه	745
North	AKKAR	Mrah El Aaliq	مراح العليق	920
North	AKKAR	Mrah El Amir	مراح الأمير	745
North	AKKAR	Mrah El Khaoukh	مراح الخوخ	865
North	AKKAR	Mrahbat Aakar	مراحت عكار	785
North	AKKAR	Nabaa El Ghazleïh	نبع الغازيه	745
North	AKKAR	Nabaa El Safa	نبع الصفا	745



RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
North	AKKAR	Nabi Ayoub	نبي أيوب	1100
North	AKKAR	Nabi Barm	نبي بزم	745
North	AKKAR	Nabi Khaled	نبي خالد	1100
North	AKKAR	Nabi Youniss	نبي يونس	970
North	AKKAR	Nahrinye	نهرية	745
North	AKKAR	Nasrneh	ناصرية	745
North	AKKAR	Nemmeaa	نعمية	975
North	AKKAR	Nemisse	نميسة	745
North	AKKAR	Noura el Fsouq	نورا الفوقا	745
North	AKKAR	Noura el Tahha	نورا التاحا	745
North	AKKAR	Oboula	أوبولا	760
North	AKKAR	Omar El Din	عمر الدين	745
North	AKKAR	Duadi El Jamous	وادي الجموس	745
North	AKKAR	Duadi Khaled	وادي خالد	745
North	AKKAR	Durtoussa	أدورتوسا	995
North	AKKAR	Qaabrine	قابرين	745
North	AKKAR	Qabailit	قبايليت	790
North	AKKAR	Qaber El Baddawi	قبر البديوي	895
North	AKKAR	Qaber El Tourkman	قبر التركمان	920
North	AKKAR	Qalaaet El Borj	قلعة البرج	755
North	AKKAR	Qamoussa	قاموسة	1100
North	AKKAR	Qantara	القنطرة	745
North	AKKAR	Qaraha	قارها	752
North	AKKAR	Qarqaf	قرقف	745
North	AKKAR	Qarabeh	قرابيه	945
North	AKKAR	Qatteh	قطة	745
North	AKKAR	Qbour El Bid	قبور البيض	745
North	AKKAR	Qmieh	قمية	831
North	AKKAR	Qlalaat	قلايات	745
North	AKKAR	Qloud El Barqinye	قلايد البرقية	745
North	AKKAR	Qobet Chamma	قبة شاما	745
North	AKKAR	Qochloq	قشلق	745
North	AKKAR	Qorne	قورنة	1100
North	AKKAR	Qoubaiyat El Fawqa	قلايات الفوقا	820
North	AKKAR	Qoubaiyat el Gharbiye	قلايات الغربية	790
North	AKKAR	Qoubaiyat ez Zouq	قلايات الزوق	765
North	AKKAR	Qraiyet	قرايت	970
North	AKKAR	Qs-air	القصور	745
North	AKKAR	Quadi el Hour	وادي الحور	745
North	AKKAR	Rababiyeh	رعابية	745
North	AKKAR	Rahbeh	راهبه	795
North	AKKAR	Rihariyye	الريحية	745
North	AKKAR	Rijem Beit Hsain	ريجم بيت حسان	745
North	AKKAR	Rimeh en Nahrinye	ريمه عن نهرية	745
North	AKKAR	Rimoul	ريمول	745
North	AKKAR	Saadine	سادين	745
North	AKKAR	Sabaghia	سباحية	745
North	AKKAR	Sadqa	سدقة	770
North	AKKAR	Safinet ed Draib	سافينة الدرايب	745
North	AKKAR	Safinet El Qalteea	سافينة القلعة	850
North	AKKAR	Sahle	ساحية	845
North	AKKAR	Saida	سيدا	745
North	AKKAR	Saidet Kmaa	سيدة كماما	945
North	AKKAR	Saidmaya	سيدمايا	745
North	AKKAR	Saissouq	سايسوق	745
North	AKKAR	Sermeajiyeh	السرمةية	745
North	AKKAR	Sindianet El Kawachra	سندية الكواشرا	745
North	AKKAR	Sindianet Zaidan	سندية زيدان	765
North	AKKAR	Souaisse	سواسية	745
North	AKKAR	Soutan Ibrahim	سوتان ابراهيم	745
North	AKKAR	Srar	سزار	745
North	AKKAR	Tacheaa	تاشع	1060
North	AKKAR	Tahoun El Aaboudeh	طاهون العوده	745
North	AKKAR	Takrit	تكريت	765
North	AKKAR	Tall Aabbas el Gharbi	تل اعباس الغربي	745
North	AKKAR	Tall Abbas-eth Charq	تل اعباس الشرقي	745
North	AKKAR	Tall Bibi	تل بيبى	745
North	AKKAR	Tall Bire	تل بيرة	745
North	AKKAR	Tall El Hayet	تل الحيات	745
North	AKKAR	Tall El Zafir	تل الزفير	745
North	AKKAR	Tall Himaire	الخميرة	745
North	AKKAR	Tall Kiri	تل كيري	745
North	AKKAR	Tall Lajjini	تل لاجيني	745
North	AKKAR	Tall Meaalan	المديان	745
North	AKKAR	Tall Sibaael	تل سيبعل	745
North	AKKAR	Tall Zaka	تل زكا	745
North	AKKAR	Talle	تالعة	745
North	AKKAR	Tallet El Mjabbir	تلة المصبر	745
North	AKKAR	Tallet El Zraaa	تلة الزراعة	745
North	AKKAR	Tallet Tibis	تلة الطيبس	820
North	AKKAR	Tallet W Shaitha	تلة وشايتا	770
North	AKKAR	Tlaieeh	تلايه	767
North	AKKAR	Wadi El Hawr	وادي الحور	745
North	AKKAR	Wata	وطني	745
North	AKKAR	Zaboud	زابد	975
North	AKKAR	ZakZouk	زكرك	745
North	AKKAR	Zouarb	الزورب	745
North	AKKAR	Zouq El Baacha	زوق الباشا	745
North	AKKAR	Zouq el Habalsaa	زوق الحبالسا	745
North	AKKAR	Zouq El Hassine	زوق الحسنية	745
North	AKKAR	Zouq El Magachrine	زوق المشرف	745
North	AKKAR	Zouq Habara	زوق حنارة	745
North	BATROUN	Aabdelle	عبدالي	815
North	BATROUN	Aabrine	عبرين	745
North	BATROUN	Aafs	العفس	745
North	BATROUN	Aalali	العالي	920
North	BATROUN	Aaoura	عوزاء	850
North	BATROUN	Aaqabeh	العقبة	870
North	BATROUN	AanteE	عطر	745
North	BATROUN	Aazaqa	العزقة	745
North	BATROUN	Ain Billawte	عين بلوز	1100
North	BATROUN	Ain El Bateh	عين الباطية	1100
North	BATROUN	Ain El Biat	عين البلاط	1100
North	BATROUN	Ain Chemouna	عين شونان	745
North	BATROUN	Ain El Raha	عين الرحة	1020
North	BATROUN	Arez Niha	أرز نيجا	1100
North	BATROUN	Arez Tamourin	أرز الطورين	1100
North	BATROUN	Assia	اسيا	895
North	BATROUN	Balaa	بلعه	1100
North	BATROUN	Basbina	باسبينا	745
North	BATROUN	Batha	بطحنا	1050
North	BATROUN	Batroun	البترون	745
North	BATROUN	Bcheale	بشعل	845

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
North	AKKAR	Nabi Ayoub	نبي أيوب	1100
North	AKKAR	Nabi Barm	نبي بزم	745
North	AKKAR	Nabi Khaled	نبي خالد	1100
North	AKKAR	Nabi Youniss	نبي يونس	970
North	AKKAR	Nahrinye	نهرية	745
North	AKKAR	Nasrneh	ناصرية	745
North	AKKAR	Nemmeaa	نعمية	975
North	AKKAR	Nemisse	نميسة	745
North	AKKAR	Noura el Fsouq	نورا الفوقا	745
North	AKKAR	Noura el Tahha	نورا التاحا	745
North	AKKAR	Oboula	أوبولا	760
North	AKKAR	Omar El Din	عمر الدين	745
North	AKKAR	Duadi El Jamous	وادي الجموس	745
North	AKKAR	Duadi Khaled	وادي خالد	745
North	AKKAR	Durtoussa	أدورتوسا	995
North	AKKAR	Qaabrine	قابرين	745
North	AKKAR	Qabailit	قبايليت	790
North	AKKAR	Qaber El Baddawi	قبر البديوي	895
North	AKKAR	Qaber El Tourkman	قبر التركمان	920
North	AKKAR	Qalaaet El Borj	قلعة البرج	755
North	AKKAR	Qamoussa	قاموسة	1100
North	AKKAR	Qantara	القنطرة	745
North	AKKAR	Qaraha	قارها	752
North	AKKAR	Qarqaf	قرقف	745
North	AKKAR	Qarabeh	قرابيه	945
North	AKKAR	Qatteh	قطة	745
North	AKKAR	Qbour El Bid	قبور البيض	745
North	AKKAR	Qmieh	قمية	831
North	AKKAR	Qlalaat	قلايات	745
North	AKKAR	Qloud El Barqinye	قلايد البرقية	745
North	AKKAR	Qobet Chamma	قبة شاما	745
North	AKKAR	Qochloq	قشلق	745
North	AKKAR	Qorne	قورنة	1100
North	AKKAR	Qoubaiyat El Fawqa	قلايات الفوقا	820
North	AKKAR	Qoubaiyat el Gharbiye	قلايات الغربية	790
North	AKKAR	Qoubaiyat ez Zouq	قلايات الزوق	765
North	AKKAR	Qraiyet	قرايت	970
North	AKKAR	Qs-air	القصور	745
North	AKKAR	Quadi el Hour	وادي الحور	745
North	AKKAR	Rababiyeh	رعابية	745
North	AKKAR	Rahbeh	راهبه	795
North	AKKAR	Rihariyye	الريحية	745
North	AKKAR	Rijem Beit Hsain	ريجم بيت حسان	745
North	AKKAR	Rimeh en Nahrinye	ريمه عن نهرية	745
North	AKKAR	Rimoul	ريمول	745
North	AKKAR	Saadine	سادين	745
North	AKKAR	Sabaghia	سباحية	745
North	AKKAR	Sadqa	سدقة	770
North	AKKAR	Safinet ed Draib	سافينة الدرايب	745
North	AKKAR	Safinet El Qalteea	سافينة القلعة	850
North	AKKAR	Sahle	ساحية	845
North	AKKAR	Saida	سيدا	745
North	AKKAR	Saidet Kmaa	سيدة كماما	945
North	AKKAR	Saidmaya	سيدمايا	745
North	AKKAR	Saissouq	سايسوق	745
North	AKKAR	Sermeajiyeh	السرمةية	745



RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
North	BATROUN	Bchehall	بشحة	1100
North	BATROUN	Bechtoudar	بشوتار	955
North	BATROUN	Beit Chiala	بيت شلالا	805
North	BATROUN	Beit Kassab	بيت كاسب	995
North	BATROUN	Bijdarfel	بجدارفيل	745
North	BATROUN	Biyad	البياض	745
North	BATROUN	Birzaqin	برزاقين	745
North	BATROUN	Blat	البلاط	1020
North	BATROUN	Boroj	البروج	745
North	BATROUN	Boustane El Aassi	بوسطن العاصي	785
North	BATROUN	Bitbat	ببببات	1070
North	BATROUN	Bqalaa	البقعة	785
North	BATROUN	Bqosmayya	بقسما	745
North	BATROUN	Chaabiyeh	شعبية	1100
North	BATROUN	Chabline	شبابين	745
North	BATROUN	Chatine	شاكين	1100
North	BATROUN	Chekka	شكا	745
North	BATROUN	Chekka El Aabiga	شكا العبيطة	745
North	BATROUN	Daael	داعل	820
North	BATROUN	Dahr Abi Yaghi	دهور ابي ياضي	770
North	BATROUN	Dahr El Qatlab	دهور القلاب	770
North	BATROUN	Dawra	الداروة	745
North	BATROUN	Deir Bassa	دير بسمه	982
North	BATROUN	Deir Billia	دير بيل	860
North	BATROUN	Deir Chouwah	دير شواح	745
North	BATROUN	Deir Kiffane	دير كيفان	745
North	BATROUN	Deir Houb	دير هوب	1100
North	BATROUN	Deir Mar Doumet	دير مار دومت	1100
North	BATROUN	Deir Mar Richa	دير مار ريشا	745
North	BATROUN	Deir Mar Youhana Maroun	دير مار يوحنا مارون	745
North	BATROUN	Deir Mar Youssef	دير مار يوسف (خبرنا)	745
North	BATROUN	Deir Mar Youssef	دير مار يوسف (عشرون)	745
North	BATROUN	Deir Nouniyeh	دير النورية	745
North	BATROUN	Derna	دنرا	752
North	BATROUN	Diria	دنريا	750
North	BATROUN	Douma	دوما	1025
North	BATROUN	Douq	دوق	900
North	BATROUN	Dwair	الدوير	1100
North	BATROUN	Eddle	اذه	745
North	BATROUN	El - Heri	الهرى	745
North	BATROUN	Fadaaous	فادعوس	745
North	BATROUN	Fahta	فحفا	1100
North	BATROUN	Fawar	الفوار	1100
North	BATROUN	Fayadiyeh	فياضية	1100
North	BATROUN	Fitra	فترا	920
North	BATROUN	Fihat	فحات	770
North	BATROUN	Ghouma	غوما	745
North	BATROUN	Haditoun	حدان	1010
North	BATROUN	Halha	حفا	810
North	BATROUN	Hamat	حمات	745
North	BATROUN	Hannouch	حشوش	745
North	BATROUN	Harbouna	حزونا	745
North	BATROUN	Hardine	حزنين	1015
North	BATROUN	Harisa	حريسا	1100
North	BATROUN	Hourata	حورتا	1100
North	BATROUN	Jidabra	اجدرا	745

North	BATROUN	Jabla	جبل	745
North	BATROUN	Jirni	الجندى	915
North	BATROUN	Jrane	جران	745
North	BATROUN	Jreba	جرينا	755
North	BATROUN	Kfar Abbeida	كفر عبينا	745
North	BATROUN	Kfar Chlaimane	كفر شليمان	845
North	BATROUN	Kfar Hatna	كفر حنا	745
North	BATROUN	Kfar Hay	كفر حى	745
North	BATROUN	Kfar Helda	كفر هنده	815
North	BATROUN	Kfar Khoullos	كفر حلس	745
North	BATROUN	Kifane	كيفان	745
North	BATROUN	Kfour El Aarbi	كفور العرقي	1030
North	BATROUN	Khirhil	خربل	1100
North	BATROUN	Khormelaya	خرملايا	1100
North	BATROUN	Khralbeh	الخرية	770
North	BATROUN	Kibraya	كبرايا	1100
North	BATROUN	Koubba	كوبا	745
North	BATROUN	Kour	كور	745
North	BATROUN	Ksara	القسارة	1100
North	BATROUN	Madfoun	المدفون	745
North	BATROUN	Mahlisa	مخيسا	1045
North	BATROUN	Mar Abdallah	مار عبد الله	765
North	BATROUN	Mar Chira	مار شيرا	995
North	BATROUN	Mar Elias	مار الياس	745
North	BATROUN	Mar Hanna	مار حنا	1007
North	BATROUN	Mar Jorjes	مار جرجس	995
North	BATROUN	Mar Maima	مار ماما	940
North	BATROUN	Mar Michael	مار ميخايل	1100
North	BATROUN	Mar Saba	مار سابا	880
North	BATROUN	Mar Sarkis	مار سركيس	1100
North	BATROUN	Mar Simean	مار سيمان	745
North	BATROUN	Mar Touma	مار توما	915
North	BATROUN	Mar Yaacoub	مار يعقوب	1020
North	BATROUN	Markaz	المركز	1100
North	BATROUN	Masrah	مسرح	850
North	BATROUN	Mimmarche	ميمشوش	955
North	BATROUN	Mrah Chdid	مزراع بو شديب	745
North	BATROUN	Mrah El Hajj	مزراع الحاج	870
North	BATROUN	Mrah Ez Zalal	مزراع الزالك	745
North	BATROUN	Mrouj	المروج	1100
North	BATROUN	Nahle	نحلة	905
North	BATROUN	Nahrinyeh	النهرية	745
North	BATROUN	Neagra	نقرايا	745
North	BATROUN	Niha	نيما	1100
North	BATROUN	Niha	نيحا	920
North	BATROUN	Quata Haub	واطن حوب	1100
North	BATROUN	Qalaa	القعة	745
North	BATROUN	Qalaat El Hosn	قعة الحصن	1100
North	BATROUN	Qalaat EL Mhalha	قعة المشقة	745
North	BATROUN	Qandoula	قندولا	920
North	BATROUN	Qamaoun	قماون	745
North	BATROUN	Qornit El Mrah	قورنه المزراع	920
North	BATROUN	Qualh El - Hajjar	وحد الحجر	745
North	BATROUN	Racha	رشا	955
North	BATROUN	Rachana	راشقا	745
North	BATROUN	Rachkaidah	راشكيداه	745
North	BATROUN	Rachkiddah	راشكيداه	765

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
North	BATROUN	Ram	رام	1085
North	BATROUN	Ramat	رامات	745
North	BATROUN	Ras Chagaa	راس الشغاة	745
North	BATROUN	Ras Nhsache	راس النحاش	745
North	BATROUN	Rweils	الرؤيس	945
North	BATROUN	Salaa	سلعة	745
North	BATROUN	Salaata	سلاتا	745
North	BATROUN	Sghar	صغار	745
North	BATROUN	Smal Jball	سمل جبال	745
North	BATROUN	Sourat	سورات	745
North	BATROUN	Tannourine el Faouq	طنون القوقا	1100
North	BATROUN	Tannourine Et Talha	طنون القحيا	955
North	BATROUN	Tel Ras Mdash	تل راس مداش	745
North	BATROUN	Thoum	ثوم	745
North	BATROUN	Toula	تولا	820
North	BATROUN	Wata Sfarta	وطني صفرتا	745
North	BATROUN	Yarita	ياريتا	820
North	BATROUN	Zane	زان	782
North	BATROUN	Ziri	الزيري	785
North	BCHARRE	Aabidine	عابدين	975
North	BCHARRE	Aarichana	عريشة	1100
North	BCHARRE	Ain Baqrah	عين بقرة	1100
North	BCHARRE	Aaziyata	عزيباتا	1100
North	BCHARRE	Al Arz	الأرز	1100
North	BCHARRE	Bane	بان	1100
North	BCHARRE	Bain El Nahrain	بين النهرين	845
North	BCHARRE	Barhallioun	برخالون	1000
North	BCHARRE	Barzabun	برزبون	1100
North	BCHARRE	Bcharne	بشارني	1100
North	BCHARRE	Beit El Cheaar	بيت الشعار	845
North	BCHARRE	Beit Mienzer	بيت مينزر	1070
North	BCHARRE	Beit Raad	بيت رعد	1100
North	BCHARRE	Billa	بلا	1090
North	BCHARRE	Blouza	بلوزا	1100
North	BCHARRE	Bnahleeh	بنهله	1100
North	BCHARRE	Bqaa Kafra	بقة كفر	1100
North	BCHARRE	Bqerqacha	بقرقاشا	1100
North	BCHARRE	Braissat	بريسات	1100
North	BCHARRE	Chana	شانا	1100
North	BCHARRE	Dehr El Qadib	دهر القديب	1100
North	BCHARRE	Deir Ooohaia	دير أولحيا (دير مار الكرنوس)	1045
North	BCHARRE	Deir Mar Lichaa	دير مار ليح	1100
North	BCHARRE	Deir Mar Simaane	دير مار سيمان	1100
North	BCHARRE	Dimane	الديمان	1100
North	BCHARRE	El Ouadi	الوادي	950
North	BCHARRE	Fam El Mizab	فام المزاب	1100
North	BCHARRE	Hadshit	حديش (عين حرق بنزري)	1100
North	BCHARRE	Hadet Ej jebbe	حدايت الجبة	1100
North	BCHARRE	Haret Cheaya	حارة شعا	1100
North	BCHARRE	Hasroun	حسرون	1100
North	BCHARRE	Hqallet Marouna	حقة مارونا	1100
North	BCHARRE	Kfar Siroun	كفر سارون	1100
North	BCHARRE	Kizbar	كيزبار	1100
North	BCHARRE	Mar Serkis	مار سركيس	1100
North	BCHARRE	Mazraat Assaf	مزرعة اساف	975
North	BCHARRE	Mazraat Beni Saalt	مزرعة بني صالت	1000

North	BCHARRE	Merit	مريت	875
North	BCHARRE	Mghareh Qadicha	مغرة قديشا	1100
North	BCHARRE	Moghtr El Ahwal	مغر الاحوال	825
North	BCHARRE	Qassouba	قاصوبا	1100
North	BCHARRE	Qatea Bou Mrad	قاعة بو مراد	1100
North	BCHARRE	Qnalouer	قنلور	1100
North	BCHARRE	Qrat	قراة	1070
North	BCHARRE	Tourza	تورزا	835
North	BCHARRE	Wadi Qanoubine	وادي القنوبين	950
North	BCHARRE	Yamleeh	ياملة	1100
North	DINNIE-MINYE	Aaimar	عيار	1040
North	DINNIE-MINYE	Ain El Sofsafe	عين السوفسة	1100
North	DINNIE-MINYE	Ain El Tineh	عين التينة	930
North	DINNIE-MINYE	Aaraman	ارمان	745
North	DINNIE-MINYE	Aasaimout	عسايوت	830
North	DINNIE-MINYE	Aassoun	عاسون	957
North	DINNIE-MINYE	Aayoun El Samak	عوان السمك	745
North	DINNIE-MINYE	Aazqi	عزقي	745
North	DINNIE-MINYE	Afqa	افقا	1045
North	DINNIE-MINYE	Baazqoun	بازقون	770
North	DINNIE-MINYE	Bahwita	بحويتا	1070
North	DINNIE-MINYE	Bakhaaboun	بكاخابون	820
North	DINNIE-MINYE	Belt Bakour	بيلت بكور	815
North	DINNIE-MINYE	Belt Dawoud	بيلت داود	875
North	DINNIE-MINYE	Belt El Aarab	بيلت العرب	745
North	DINNIE-MINYE	Belt El Chamri	بيلت الشامي	745
North	DINNIE-MINYE	Belt El Fages	بيلت الفاجس	995
North	DINNIE-MINYE	Belt Hasna	بيلت حسنا	870
North	DINNIE-MINYE	Belt Hawik	بيلت حويك	920
North	DINNIE-MINYE	Belt Hotman	بيلت حتمان	820
North	DINNIE-MINYE	Belt Jids	بيلت جيدا	920
North	DINNIE-MINYE	Belt Moumneh	بيلت مونه	1055
North	DINNIE-MINYE	Belt Radwan	بيلت رادوان	895
North	DINNIE-MINYE	Belt Zoud	بيلت زود	830
North	DINNIE-MINYE	Berkit El Hamra	بركة الحمرا	745
North	DINNIE-MINYE	Bchenata	بشنانا	1100
North	DINNIE-MINYE	Bchetaya	بشيتايا	820
North	DINNIE-MINYE	Bhamin	بهمين	745
North	DINNIE-MINYE	Bqaa Safrin	بقة صفرين	1045
North	DINNIE-MINYE	Bqarsouna	بقرسون	1020
North	DINNIE-MINYE	Btermaz	بترماز	820
North	DINNIE-MINYE	Borj El Yaloudiye	برج اليبودية	745
North	DINNIE-MINYE	Bshelin	بشيلين	865
North	DINNIE-MINYE	Bshelaj	بشلاية	1100
North	DINNIE-MINYE	Chalout	شالوط	1070
North	DINNIE-MINYE	Daraya	داريا	1070
North	DINNIE-MINYE	Debaal	ديبال	795
North	DINNIE-MINYE	Deir Aamar	دير عمار	745
North	DINNIE-MINYE	Deir Nibouh	دير نبوح	745
North	DINNIE-MINYE	El Aayoun	العوان	840
North	DINNIE-MINYE	El Arbaain	الاربعين	1100
North	DINNIE-MINYE	El Bidawi	البيدوي	745
North	DINNIE-MINYE	El Borji	البرجي	845
North	DINNIE-MINYE	El Chammas	الشمس	895
North	DINNIE-MINYE	El Daibaba	الدينبية	745
North	DINNIE-MINYE	El Dnebieh	الذنبية	745
North	DINNIE-MINYE	El Hazmieh	الحمزية	875



RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
North	DINNIE-MINYE	El Hekar	الحجر	745
North	DINNIE-MINYE	El Malha	الخالفة	855
North	DINNIE-MINYE	El Manchara	المنشارة	995
North	DINNIE-MINYE	El Maqtouaa	المقتوعة	1070
North	DINNIE-MINYE	El Mienteh	المنية	745
North	DINNIE-MINYE	El Nabi Kzaiber	النبي كزبير	745
North	DINNIE-MINYE	El Nabi Nsar	النبي نصار	1070
North	DINNIE-MINYE	El Nabi Yaacoub	النبي يعقوب	995
North	DINNIE-MINYE	El Nabi Youchaa	النبي يوشع	745
North	DINNIE-MINYE	El Qaren	القرن	970
North	DINNIE-MINYE	El Qartim	القطيم	870
North	DINNIE-MINYE	El Rawda	الروضة	745
North	DINNIE-MINYE	El Rihameh	الريمانية	745
North	DINNIE-MINYE	El Sifra	السفرة	1005
North	DINNIE-MINYE	El Snowbar	السنوبر	1045
North	DINNIE-MINYE	El Swaaj	الساوحي	1100
North	DINNIE-MINYE	El Waaleh	الواالية	745
North	DINNIE-MINYE	Faqous	فاقوس	875
North	DINNIE-MINYE	Ferjeh	فرجة	962
North	DINNIE-MINYE	Haif El Siad	حرف السيد	820
North	DINNIE-MINYE	Hawara	حوارة	985
North	DINNIE-MINYE	Hay El Aaliqa	هن العليقة	745
North	DINNIE-MINYE	Hay El Blot	هن البلاط	745
North	DINNIE-MINYE	Hesqel El Aazimeh	هسل العزيمة	895
North	DINNIE-MINYE	Hraiges	حريغس	745
North	DINNIE-MINYE	Izal	يزال	970
North	DINNIE-MINYE	Jabal El Makmal	جبل المكمل	1100
North	DINNIE-MINYE	Jabal Tirbol	جبل تربول	797
North	DINNIE-MINYE	Jaliroun	جلرون	1020
North	DINNIE-MINYE	Jilja	ججا	820
North	DINNIE-MINYE	Jount El Khouri	خورة الخوري	962
North	DINNIE-MINYE	Kahel El Malloul	كهل الملول	925
North	DINNIE-MINYE	Kam El Akhras	كرم الاخراس	745
North	DINNIE-MINYE	Kam El Mohr	كرم المهر	1020
North	DINNIE-MINYE	Kfar Bebine	كفر بيبين	1065
North	DINNIE-MINYE	Kfar Chilian	كفر شيلان	745
North	DINNIE-MINYE	Kfar Habou	كفر حابو	745
North	DINNIE-MINYE	Khamoub	خاموب	820
North	DINNIE-MINYE	Markibta	ماركيتا	745
North	DINNIE-MINYE	Marmar	مرمار	805
North	DINNIE-MINYE	Mazraat Ketran	مزرعة كتران	745
North	DINNIE-MINYE	Mgharet El Cheikh	مغارة الشيخ	1055
North	DINNIE-MINYE	Moulid	موليد	840
North	DINNIE-MINYE	Mrah El Sfirah	مراح السفرة	945
North	DINNIE-MINYE	Mrah El Srailj	مراح السرايخ	755
North	DINNIE-MINYE	Mrebin	مرابين	1100
North	DINNIE-MINYE	Nabaa El Sokar	نابعا السكار	1100
North	DINNIE-MINYE	Nemrine	نمرين	970
North	DINNIE-MINYE	Qarhais	قرحايس	745
North	DINNIE-MINYE	Qarisita	قارسيتا	1070
North	DINNIE-MINYE	Qimmamin	قمامين	895
North	DINNIE-MINYE	Qornet El Sawda	قرنة السوداء	1100
North	DINNIE-MINYE	Qralin	قرلين	845
North	DINNIE-MINYE	Ramlet El Hamra	رامة الحمرا	1090
North	DINNIE-MINYE	Sartouka	ساروكا	895
North	DINNIE-MINYE	Sir el Dinnye	سير	952

North	DINNIE-MINYE	Taran	طران	825
North	DINNIE-MINYE	Tribol	تربول	795
North	DINNIE-MINYE	Termalik	ترمليك	815
North	DINNIE-MINYE	Wadi El Nahle	وادي النحلة	745
North	DINNIE-MINYE	Wadi El Njass	وادي النجاص	1100
North	DINNIE-MINYE	Wadi Jhanam	وادي جهنم	1100
North	DINNIE-MINYE	Wadi Serr	وادي سيري	895
North	DINNIE-MINYE	Zghrighnin	زغريغرين	895
North	KOURA	Aaba	عابا	745
North	KOURA	Aafsdliq	عافسديق	745
North	KOURA	Ain Aakrine	عين عاكرين	815
North	KOURA	Ain Frachlo	عين فرشلو	745
North	KOURA	Ain Iqach	عين ايقاش	745
North	KOURA	Amoun	امون	745
North	KOURA	Bahbouch	بهبوش	745
North	KOURA	Balamend	بلمند	745
North	KOURA	Barghoun	بارغون	745
North	KOURA	Barsa	بارسا	745
North	KOURA	Batroumine	باطرومين	745
North	KOURA	Bocihoun	بوشون	745
North	KOURA	Bolbiba	بولببا	745
North	KOURA	Bechmizine	بشمزين	745
North	KOURA	Bednayeil	بدينايل	745
North	KOURA	Blefune	بلكفين	745
North	KOURA	Bkonra	بكونرا	745
North	KOURA	Bnehrane	بنهران	780
North	KOURA	Bsarma	بسمارما	745
North	KOURA	Blaaboura	بلابورة	745
North	KOURA	Btouratij	بثوراتيج	745
North	KOURA	Btouratim	بثوراتيم	745
North	KOURA	Beiza	بوزبا	745
North	KOURA	Charlita	شارلينا	745
North	KOURA	Chira	شيرا	852
North	KOURA	Chnata	شانتا	775
North	KOURA	Dahr El Ain	ضهر العين	745
North	KOURA	Dar Baachtar	دار بباختار	745
North	KOURA	Dar chmizine	دار شمزين	745
North	KOURA	Debdde	دبد	745
North	KOURA	Deir El Balamand	دير البلمند	745
North	KOURA	Deir Saïdet El Baniyeh	دير سيدة البنية	745
North	KOURA	Deir Saïdet EL Njajet (Bsarma)	دير سيدة النجاة (بسمارما)	745
North	KOURA	Deir Saïdet El Natour	دير سيدة الناتور	745
North	KOURA	Dhou El Hawa	شهور الهوا	745
North	KOURA	El Aaqebeh	العقبه	745
North	KOURA	El Bahsas	البحساس	745
North	KOURA	El Harig	الحرق	745
North	KOURA	El Nakhle	النخلة	745
North	KOURA	El Rwalis	الرزاليس	745
North	KOURA	Emfe	امفة	745
North	KOURA	Fiaa	فيا	745
North	KOURA	Hacq Zwaïn	حقل زواين	745
North	KOURA	Haret El Ain	حارة العين	745
North	KOURA	Haret El Khalta	حارة الخالطة	745
North	KOURA	Jlabbine	الجابون	745
North	KOURA	Jlaïdet Barqacha	جلاديت بارقاشا	745
North	KOURA	Kaftoun	كفتون	745
North	KOURA	Kribata	كربتا	745

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

North	TRIPOU	Kfar Bebbine	كفر بيبين	1065
North	TRIPOU	Kfar Chillane	كفر شيلان	745
North	TRIPOU	Kfar Habou	كفر حبو	745
North	TRIPOU	Kharoub	كروبو	825
North	TRIPOU	Markabta	مركابتا	745
North	TRIPOU	Mrah Es Sreij	مراح السريج	755
North	TRIPOU	Nemrine Et Bkoura	نمرون وبكورا	970
North	TRIPOU	Qarsita	قوسيتا	1050
North	TRIPOU	Qiatine	قياطينه	870
North	TRIPOU	Qemmine	قلممين	895
North	TRIPOU	Qrain	قراين	845
North	TRIPOU	Sfire	سفيوره	1005
North	TRIPOU	Sir Ed Donie	سير العدونية	945
North	TRIPOU	Terbol	تربول	795
North	TRIPOU	Trablous	طرابلس	745
North	TRIPOU	Zgharighrine	زغريغرين	890
North	ZGHARTA	Aarhach	عراش	745
North	ZGHARTA	Aadwi	عادي	745
North	ZGHARTA	Aalms	عالمس	745
North	ZGHARTA	Aarbet Oochaiya	عزبة لؤحيا	990
North	ZGHARTA	Aardat	عزادات	745
North	ZGHARTA	Aarfess	عرفس	745
North	ZGHARTA	Aaqbeh	عقبة	875
North	ZGHARTA	Ain Tourine	عين طورين	1100
North	ZGHARTA	Aitou	ايطو	970
North	ZGHARTA	Arde	ارده	745
North	ZGHARTA	Aslout	اسلوت	970
North	ZGHARTA	Asroun	اسرون	745
North	ZGHARTA	Balfoum	بلفوم	805
North	ZGHARTA	Balader Raschaain	بيلادر راشاين	745
North	ZGHARTA	Basfougit	بساطوقيت	1100
North	ZGHARTA	Beit Qnabi	بيت قنابي	745
North	ZGHARTA	Bchihara	بشخار	815
North	ZGHARTA	Bchama	بشاما	745
North	ZGHARTA	Bchamine	بشامين	745
North	ZGHARTA	Beit Abbeid	بيت عبيد	745
North	ZGHARTA	Beit Aaoukar	بيت عوكر	745
North	ZGHARTA	Beit Barakat	بيت باركات	745
North	ZGHARTA	Beit Daoud	بيت داود	875
North	ZGHARTA	Bhaira (el)	البجيرة	1070
North	ZGHARTA	Bnichaal	بشعي	745
North	ZGHARTA	Bouhairat Toula	بجيرة طولا	1070
North	ZGHARTA	Bousit	بوسيط	790
North	ZGHARTA	Bqoufa	بقوفا	1100
North	ZGHARTA	Bsbaal	بشبال	745
North	ZGHARTA	Daraya	داريا	745
North	ZGHARTA	Deir Hamatoura	دير حماتورا	745
North	ZGHARTA	Deir Mar Jerjes (Aachach)	دير مار جرجس (ااشاخ)	745
North	ZGHARTA	Deir Mar Jerjes (Ijbaal)	دير مار جرجس (الجبال)	1070
North	ZGHARTA	Deir Mar Jerjes (Hammatoura)	دير مار جرجس (حماتورا)	847
North	ZGHARTA	Deir Mar Sarkis	دير مار سركيس	1100
North	ZGHARTA	Deir Mar Simaan	دير مار سيمان	1060
North	ZGHARTA	Deir Mar Yaaqoub	دير مار يعقوب	870
North	ZGHARTA	Deir Mart Moura	دير مارت مورا	745
North	ZGHARTA	Ehden	اھدن	1100
North	ZGHARTA	El Aaqbeh	العقبة	745
North	ZGHARTA	El Hara El Jaifida	الحارة الجيدة	745

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
North	KOUBA	Kfar Aaqqa	كفر عقا	745
North	KOUBA	Kfar Hsta	كفر حستا	745
North	KOUBA	Kfar Hazir	كفر حزر	745
North	KOUBA	Kfar Qahel	كفر قاهل	745
North	KOUBA	Kfar Saroun	كفر سارون	745
North	KOUBA	Kifraya	كفرايا	745
North	KOUBA	Kousba	كوسبا	745
North	KOUBA	Majdel	مجدل	745
North	KOUBA	Mjaldel	مجدل	745
North	KOUBA	Mar Faoua	مار فوا	745
North	KOUBA	Mar Semean	مار سيمان	745
North	KOUBA	Mar Yaaqoub	مار يعقوب	745
North	KOUBA	Mar Youhanna	مار يوحنا	745
North	KOUBA	Mirah El Habcheh	مراح الحاشي	745
North	KOUBA	Qalhat	قحط	745
North	KOUBA	Ras Masqa El Chmaliye	راس مسقا الشملية	745
North	KOUBA	Ras Masqa El Janoubieh	راس مسقا الجنوبية	745
North	KOUBA	Rechdabin	رشدين	832
North	KOUBA	Waata Fares	واطي فارس	745
North	KOUBA	Zakroun	زكرون	745
North	KOUBA	Zakrouk	زكروك	745
North	KOUBA	Zgarta El Mitoule	زغرتا المتولة	860
North	TRIPOU	Aamsar	عاصر	1020
North	TRIPOU	Aassalmout	عصموت	830
North	TRIPOU	Aassoun	عصون	967
North	TRIPOU	Abou Helga	ابو حلغا	745
North	TRIPOU	Ain Et Time	عين التين	1090
North	TRIPOU	Azqey	ازكي	745
North	TRIPOU	Bakhaoun	بਖون	810
North	TRIPOU	Beit El Arabe	بيت العرب	920
North	TRIPOU	Beit El Feqs	بيت القس	975
North	TRIPOU	Beit Hasouk	بيت حاسوك	915
North	TRIPOU	Beit Haimarne	بيت حمانه	820
North	TRIPOU	Boqi El Yalhoudiye	بورج الالودية	745
North	TRIPOU	Bqaa Sefrin	بقاغ سفرون	995
North	TRIPOU	Bqarsouna	بقرسونا	1010
North	TRIPOU	Btahline	بطين	865
North	TRIPOU	Bloumaz	بلماز	818
North	TRIPOU	Chalout	شالوت	1100
North	TRIPOU	Deir Amar	دير عمار	745
North	TRIPOU	Deir Nbouh	دير نبوح	745
North	TRIPOU	El Beddeoui	البيدي	745
North	TRIPOU	El Mina	المناء	745
North	TRIPOU	El Minie	المنية	745
North	TRIPOU	El Qlamboun	القلمون	745
North	TRIPOU	En Nahi Youchaa	النهي يوشع	745
North	TRIPOU	Hazoura	حورا	985
North	TRIPOU	Hagl El Aazime	حقل الازيمه	875
North	TRIPOU	Haret E Charfeh	حارة الشرفه	745
North	TRIPOU	Hart Es Fouar	حارة الفوار	745
North	TRIPOU	Hart Es saiyad	حارة الساياد	830
North	TRIPOU	Hazmiye	حازمية	875
North	TRIPOU	Izal	يزال	975
North	TRIPOU	Jairoun	جورون	1020
North	TRIPOU	Kahf El - Malloul	كهف الملول	965
North	TRIPOU	Karm El - Mohr	كرم المهر	1020



## RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
North	ZGHARTA	El Jbbeh	الجبية	745
North	ZGHARTA	El Khaldeh	الخالقة	745
North	ZGHARTA	El Tallah	التل	745
North	ZGHARTA	El Qadriye	القادية	745
North	ZGHARTA	Fradis	الفرديس	850
North	ZGHARTA	Hairouna	حزونا	875
North	ZGHARTA	Hsouqa El Naher	حوق النهر	755
North	ZGHARTA	Harf Hazir	حرف حزير	840
North	ZGHARTA	Harret El Fawar	حرف الفوار	745
North	ZGHARTA	Harf Mizaira	حرف ميزارة	965
North	ZGHARTA	Harf Arde	حرف ارده	745
North	ZGHARTA	Hawqa	حوقا	1100
North	ZGHARTA	Hillane	حيلان	745
North	ZGHARTA	Himalis	حيمليس	870
North	ZGHARTA	laal	الهدل	745
North	ZGHARTA	Ijbaa	الجب	1070
North	ZGHARTA	Joudeh	جوجة	745
North	ZGHARTA	Kaabouch	كعبوش	745
North	ZGHARTA	Kaif Zaina	كاف زينا	745
North	ZGHARTA	Kalfriya	كالفريا	755
North	ZGHARTA	Karabeh	كارابح	745
North	ZGHARTA	Karariba	كاراربا	745
North	ZGHARTA	Karm Sodde	كاردسده	795
North	ZGHARTA	Kfar Chakfina	كفر شاكفينا	745
North	ZGHARTA	Kfar elqous	كفر لقوس	745
North	ZGHARTA	Kfar Fou	كفر فو	745
North	ZGHARTA	Kfar Hada	كفر حدا	745
North	ZGHARTA	Kfar Haoura	كفر حورا	745
North	ZGHARTA	Kfar Sghab	كفر صغاب	1100
North	ZGHARTA	Kfar Yachit	كفر ياشيت	745
North	ZGHARTA	Laal	لاال	745
North	ZGHARTA	Majdalaya	مجداليا	745
North	ZGHARTA	Mar Abda	مار عبا	1100
North	ZGHARTA	Mar Jerjes	مار جرجس	1007
North	ZGHARTA	Mazraat Balhiss	مزرعة البهيس	1100
North	ZGHARTA	Mazraat El Naher	مزرعة النهر	780
North	ZGHARTA	Mazraat El Toufah	مزرعة الطوفاح	935
North	ZGHARTA	Mazraat Hraliqs	مزرعة حرقيس	745
North	ZGHARTA	Mingita	ميرغيتا	745
North	ZGHARTA	Miziara	مزيارة	890
North	ZGHARTA	North Kfar Sghab	مزرعة كفر صغاب	745
North	ZGHARTA	Nabaa Fraijeh	نابعا فريجة	855
North	ZGHARTA	Nabaa Jouaill	نابعا جوعيت	1100
North	ZGHARTA	Nabaa Mar Sarkis	نابعا مار سركيس	1100
North	ZGHARTA	Rachalain	راشالين	745
North	ZGHARTA	Raskifa	راسكيفا	745
North	ZGHARTA	Richtamout	ريشتموت	845
North	ZGHARTA	Rimaleh	ريماله	745
North	ZGHARTA	Saidet El Hpson	سيدة الحسطن	1100
North	ZGHARTA	Sakha	سكها	745
North	ZGHARTA	Sebaal	سببال	805
North	ZGHARTA	Selouane Sghab	سلوان صغاب	1100
North	ZGHARTA	Seraal	سرعيل	850
North	ZGHARTA	Toula	تولا	1055
North	ZGHARTA	Zgharta	زغرتا	745
South	JAZZINE	Aadour	عاشور	885

South	JAZZINE	Aaichiyeh	العجينة	735
South	JAZZINE	Aain El Tafra	عين الطفرة	960
South	JAZZINE	Aaramfa	عرقسي	900
South	JAZZINE	Aariye	عزيرة	730
South	JAZZINE	Aaroub	عزروب	700
South	JAZZINE	Aazibeh	عزيبه	980
South	JAZZINE	Aazour	عزازور	820
South	JAZZINE	Ain el Mir	عين المير	655
South	JAZZINE	Ain Majdalaïn	عين مجدالين	1100
South	JAZZINE	Anane	الن	715
South	JAZZINE	Baanoub	بناوب	655
South	JAZZINE	Baba	بابا	750
South	JAZZINE	Balssour	بلسور	655
South	JAZZINE	Bhannine	بحنين	715
South	JAZZINE	Binwari	بناري	785
South	JAZZINE	Bisri	بصري	655
South	JAZZINE	Bkassine	بكاسين	810
South	JAZZINE	Bouslaya	بوسلاية	755
South	JAZZINE	Bredine el Lough	بشدين اللق	815
South	JAZZINE	Chball	شبال	815
South	JAZZINE	Chamkha	شامخة	850
South	JAZZINE	Chamkha	شامخة	655
South	JAZZINE	Chouliq	شوليق	655
South	JAZZINE	Chouliq	شوليق	705
South	JAZZINE	Chouliq	شوليق	705
South	JAZZINE	Dahr El Deir	دهر الزم	655
South	JAZZINE	Dahr El Ramleh	دهر الزم	905
South	JAZZINE	Daraya	داريا	655
South	JAZZINE	Deir El Mkhales	دير المخالس	855
South	JAZZINE	Deir El Seydeh	دير السيده	830
South	JAZZINE	Deir Mar Jerjes	دير مار جرجس	980
South	JAZZINE	Deir Qatin	دير قطين	885
South	JAZZINE	Dighari	ديغاري	800
South	JAZZINE	Dillacha	دلاشا	755
South	JAZZINE	Dimechayeh	دشمخة	655
South	JAZZINE	El Aarimeh	العزيمة	905
South	JAZZINE	El Biada	البياصة	955
South	JAZZINE	El Houranleeh	العورانية	730
South	JAZZINE	El Marj	المرج	805
South	JAZZINE	El Messous	المسوس	695
South	JAZZINE	El Mghalibeh	المغلبة	695
South	JAZZINE	El Mzairaa	المزارة	1007
South	JAZZINE	El Nabaa	النابعا	730
South	JAZZINE	El Qate'	القابع	725
South	JAZZINE	El Rimmaneh	الرممانه	1100
South	JAZZINE	El Wardieh	العزيرة	695
South	JAZZINE	Rmalch	رملش	962
South	JAZZINE	Rous El Franj	روس الفرنج	655
South	JAZZINE	Ghbatyeh	الغباطية	740
South	JAZZINE	Haidab	حياط	655
South	JAZZINE	Haitroule	حيتروله	655
South	JAZZINE	Haitoura	حيتورة	935
South	JAZZINE	Harf	حرف	805
South	JAZZINE	Harf El Dqlq	حرف الدلق	705
South	JAZZINE	Hassaniye	الحسانية	655
South	JAZZINE	Homsiyeh	هومسيه	885
South	JAZZINE	Houtai	هوتاي	810
South	JAZZINE	Jabal Naha	جبل نها	1100

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

South	JAZZINE	Sabab	صباح	940
South	JAZZINE	Sallima	صليما	655
South	JAZZINE	Salloum	سلم	655
South	JAZZINE	Sajoud	سجد	920
South	JAZZINE	Sfaraj	سفارجه	655
South	JAZZINE	Sidouh	سيدر	765
South	JAZZINE	Sriye	سريا	860
South	JAZZINE	Srri	السريرة	705
South	JAZZINE	Taalid	تاليد	655
South	JAZZINE	Tamma	طامرة	855
South	JAZZINE	Tayouneh	طونين	1100
South	JAZZINE	Toumat Naha	تومت نحا	655
South	JAZZINE	Wadi El Laimoun	وادي الليمون	705
South	JAZZINE	Wazaajeh	وزاجيه	755
South	JAZZINE	Zaiboun	زبون	830
South	JAZZINE	Zighrin	زغرين	950
South	JAZZINE	Zhalta	زحطا	655
South	SAIDA	Aabra	عبرا	655
South	SAIDA	Aaddoussiye	العوسية	655
South	SAIDA	Aaitameh	عائيه	655
South	SAIDA	Abou El Aswad	ابو الاسود	655
South	SAIDA	Abou Zaid	ابو زيد	655
South	SAIDA	Aadloun	عدلون	655
South	SAIDA	Aanqour	عقن	655
South	SAIDA	Aaqtaanit	عقيت	655
South	SAIDA	Aarab Tabola	عرب طابلا	655
South	SAIDA	Aarab El Jal	عرب الجال	655
South	SAIDA	Aarab Sokar	عرب سكار	655
South	SAIDA	Aaraba	عربا	655
South	SAIDA	Ain El Deib	عين الديب	655
South	SAIDA	Ain El Helneh	عين الحلوه	655
South	SAIDA	Babllye	بابليه	765
South	SAIDA	Balssariye	البسارية	655
South	SAIDA	Barti	بزي	655
South	SAIDA	Boustan Ain El Qantara	بستان عين القنطرة	655
South	SAIDA	Braafoul	بشبول	655
South	SAIDA	Bqosta	بقسط	655
South	SAIDA	Brak El Tall	برك التال	655
South	SAIDA	Bramiye	براميه	655
South	SAIDA	Daher Tarraf	دهير تاراف	655
South	SAIDA	Daouziye	داويزيه	655
South	SAIDA	Darb es Silim	دارب السليم	655
South	SAIDA	Deir Taqla	دير تاقلا	655
South	SAIDA	El Aaqbieh	العاقبيه	655
South	SAIDA	El Bilata	البلطه	655
South	SAIDA	El khodr	الخشتر	655
South	SAIDA	El Malimoudia	الملمودية	655
South	SAIDA	El Mghairieh	المغريه	655
South	SAIDA	El Qanala	القناله	655
South	SAIDA	El QerQerchieh	القرقره	655
South	SAIDA	El Qnaltra	القنطرة	655
South	SAIDA	El Qraieh	القرية	655
South	SAIDA	El Qraieh	القرية	655
South	SAIDA	Ghassamiye	غصاميه	655
South	SAIDA	Ghazbye	غاذبيه	655
South	SAIDA	Hajje	الحجه	655
South	SAIDA	Harit Saïda	حارة صيدا	655

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
South	JAZZINE	Jabal Toura	جبل طوره	1100
South	JAZZINE	Jal Nachi	جال ناضي	805
South	JAZZINE	Jarmaq	الجرمق	655
South	JAZZINE	Jirdet Bkasin	جريدة بكاسين	755
South	JAZZINE	Jirdet el Ouadi	جريدة الوادي	755
South	JAZZINE	Jensnaya	جسنايا	655
South	JAZZINE	Jemaya	جمايا	655
South	JAZZINE	Jezine	جزين	880
South	JAZZINE	Jwar Bakich	جوار بكيش	995
South	JAZZINE	Jwar El Sous	جوار السوس	785
South	JAZZINE	Karkha	كركها	655
South	JAZZINE	Kfar Falous	كفر فالوس	655
South	JAZZINE	Kfar Houne	كفر حونة	930
South	JAZZINE	Kfar Jarra	كفر جرة	655
South	JAZZINE	Kfar Taala	كفر تالا	655
South	JAZZINE	Khalet Khazen	خلة خزان	790
South	JAZZINE	Khirkhalia	خركيا	890
South	JAZZINE	Kroum El Jabal	كروم الجبل	980
South	JAZZINE	Lebaa	لبعا	655
South	JAZZINE	Louajle	اللويزة	835
South	JAZZINE	Lwadizyeh	لويزية	700
South	JAZZINE	Marchmouche	مشموشة	850
South	JAZZINE	Mahmoudiye	المحمودية	695
South	JAZZINE	Malnouniye	الملكرية	850
South	JAZZINE	Manqle	المنقلة	655
South	JAZZINE	Mar Hanna	مار حنا	655
South	JAZZINE	Marous El Fawaq	ماروس الفوا	655
South	JAZZINE	Marous El Tahta	ماروس التاhta	655
South	JAZZINE	Mazraat Arajji	مزرعة عراحي	947
South	JAZZINE	Mazraat El Khawkh	مزرعة الخوخ	1100
South	JAZZINE	Mazraat el mathane	مزرعة المثانه	655
South	JAZZINE	Mazraat El Rokban	مزرعة الرقبان	1100
South	JAZZINE	Mazraat El Swairi	مزرعة السويري	735
South	JAZZINE	Mharbiye	المحاربية	655
South	JAZZINE	Mifane	ميفان	790
South	JAZZINE	Mjaidel	مجدال	655
South	JAZZINE	Milkh	ملخ	870
South	JAZZINE	Mirah Bou Shdid	مراخ بو شديد	795
South	JAZZINE	Mirah El Hbas	مراخ الحباس	655
South	JAZZINE	Nabaa El Taseh	نابعا التاسه	745
South	JAZZINE	Nabi Sojed	نبي سجد	967
South	JAZZINE	Ouadi jezine	وادي جزين	810
South	JAZZINE	Duqmana	دقمانا	867
South	JAZZINE	Qaitale	قايولي	850
South	JAZZINE	Qalaa Abi El Hesen	قلاية ابي الحسن	655
South	JAZZINE	Qatrani	قتراني	905
South	JAZZINE	Qattine	قطين	825
South	JAZZINE	Qoubaa	القبع	865
South	JAZZINE	Qrouh	قروخ	770
South	JAZZINE	Qtaile	قلاية	655
South	JAZZINE	Quadi Baanqoundine	وادي بانقوندين	655
South	JAZZINE	Raimat	ريماط	750
South	JAZZINE	Ransiyeh	الرسية	655
South	JAZZINE	Rifane	الرفجان	905
South	JAZZINE	Roukhsa	روكسة	695
South	JAZZINE	Roum	رؤم	850





RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

655	مزرعة كسار الرمل	SOUR	South	Mazraat Kasr El Rameil	SOUR	South	655
655	مزرعة الصروف	SOUR	South	Mazraat Mechref	SOUR	South	655
655	مزرعة ام عطية	SOUR	South	Mazraat Om Aafiyeh	SOUR	South	655
655	مجدال	SOUR	South	Mjadel	SOUR	South	655
655	مزارع العلية	SOUR	South	Mirah EL Aaqbeh	SOUR	South	655
655	مزارع العزبة الفوقا	SOUR	South	Mirah El AaziyeH El Fawqa	SOUR	South	655
655	مزارع النيار	SOUR	South	Mirah El Ibyar	SOUR	South	655
655	نبع زاب العين	SOUR	South	Nabaa Ras EL Aain	SOUR	South	655
655	نبي قاسم	SOUR	South	Nabi Qassem	SOUR	South	655
655	نخعية	SOUR	South	Nafkahiye	SOUR	South	655
655	ناقورة	SOUR	South	Naqoura	SOUR	South	655
655	نيلما	SOUR	South	Nihla	SOUR	South	655
655	ام الرب	SOUR	South	Om EL Rab	SOUR	South	655
655	ام لونه	SOUR	South	Om Touteh	SOUR	South	655
655	وادي جولو	SOUR	South	Ouadi Jilou	SOUR	South	655
655	الوزدانية	SOUR	South	Ouardaniye	SOUR	South	655
655	قبر الحج موسى	SOUR	South	Qabr El Haj Mousa	SOUR	South	655
655	القاسمية	SOUR	South	Qasmiye	SOUR	South	655
655	قانا	SOUR	South	Qana	SOUR	South	655
655	قلية	SOUR	South	Qlailieh	SOUR	South	655
655	راقية	SOUR	South	Raqiye	SOUR	South	655
655	راس العين	SOUR	South	Ras el Ain	SOUR	South	655
655	راس العليسة	SOUR	South	Ras El Mayaseh	SOUR	South	655
655	راس الناقورة	SOUR	South	Ras EL Naqoura	SOUR	South	655
655	رمتقانيه	SOUR	South	Rechiananey	SOUR	South	655
655	رمدية	SOUR	South	Rmadiye	SOUR	South	655
655	سليفا	SOUR	South	Salaa	SOUR	South	655
655	الصفاة	SOUR	South	Sammaaliye	SOUR	South	655
655	صطبلين	SOUR	South	Siddiqine	SOUR	South	655
655	سليكة بيسما	SOUR	South	Sikket Basma	SOUR	South	655
655	سزار	SOUR	South	Sour	SOUR	South	655
655	سكرا	SOUR	South	Soukara	SOUR	South	655
655	سرفا	SOUR	South	Srifa	SOUR	South	655
655	طبر ديه	SOUR	South	Tair Debba	SOUR	South	655
655	طبر الشبيه	SOUR	South	Tair Filisay	SOUR	South	655
655	طبر حرقا	SOUR	South	Tair Harfa	SOUR	South	655
655	طبر سنجات	SOUR	South	Tair Samhat	SOUR	South	655
655	لج مزارع الصبر	SOUR	South	Tal Mirah El Qasr	SOUR	South	655
655	طويري	SOUR	South	Touairi	SOUR	South	655
655	طورا	SOUR	South	Toura	SOUR	South	655
655	يارين	SOUR	South	Yarine	SOUR	South	655
655	يلامج	SOUR	South	Ynouch	SOUR	South	655
655	زبان	SOUR	South	Zabqine	SOUR	South	655
655	زومطية	SOUR	South	Zalloutiye	SOUR	South	655

655	المواقع	LOCATIONS	Gaza	Mouhafaza	Rainfall
655	الشهبية	Chehabiye	SOUR	South	655
655	شيهين	Chihine	SOUR	South	655
655	شوران	Chouran	SOUR	South	655
655	ديبان	Dibach	SOUR	South	655
655	ديبال	Debaal	SOUR	South	655
655	دير اعصص	Deir Aameess	SOUR	South	655
655	دير النهر	Deir en Naher	SOUR	South	655
655	دير كفا	Deir Kifa	SOUR	South	655
655	دير قانوم	Deir Qanoun	SOUR	South	655
655	دير قانوم ناهر	Deir Qanoun en Nahr	SOUR	South	655
655	دير قانوم العهر	Deir Qanoun el eher	SOUR	South	655
655	دراخيا	Dirdghaya	SOUR	South	655
655	البعص	El Bass	SOUR	South	655
655	البيتان	El Boustane	SOUR	South	655
655	البيشينة	El Btaichiyeh	SOUR	South	655
655	الخرية	El Khraibeh	SOUR	South	655
655	الرشدية	El Rachidiyeh	SOUR	South	655
655	الرفيد	El Rafid	SOUR	South	655
655	العلية	El Talbeh	SOUR	South	655
655	الطيرة	El Zhaira	SOUR	South	655
655	الزعرية	El Zahriyeh	SOUR	South	655
655	الحاوية الفوقه	Hallousiyet el Fouqqa	SOUR	South	655
655	الحاوية	Halloussiye	SOUR	South	655
655	حمادية	Hammadiye	SOUR	South	655
655	حطول	Hamol	SOUR	South	655
655	حداربه	Hannaroulye	SOUR	South	655
655	حمانيه	Hanniyeh	SOUR	South	655
655	حماير	Haumeiri	SOUR	South	655
655	إسكندرونة	Iskandarouna	SOUR	South	655
655	جاننا	Jannata	SOUR	South	655
655	جبال اليطم	Jbal el Botm	SOUR	South	655
655	الجين	Jebbain	SOUR	South	655
655	جليم	Jilim	SOUR	South	655
655	جوييا	Jouaiya	SOUR	South	655
655	جوار النخل	Jour en Nakhl	SOUR	South	655
655	حطول	Hamol	SOUR	South	655
655	كفراي	Kfar Nai	SOUR	South	655
655	الكنيسة	Knisse	SOUR	South	655
655	لابونة	Labboune	SOUR	South	655
655	مخترقي	Maachouq	SOUR	South	655
655	مخلة	Maaliye	SOUR	South	655
655	معركة	Maarake	SOUR	South	655
655	معروب	Maaroub	SOUR	South	655
655	مخزونة	Mahrouna	SOUR	South	655
655	مجدل زون	Majdel Zoun	SOUR	South	655
655	مخليكة الساحل	Malkiyet es Sahel	SOUR	South	655
655	المسحوري	Mansouri	SOUR	South	655
655	مزيا	Marmaba	SOUR	South	655
655	مزوجين	Marouahine	SOUR	South	655
655	مظورة	Matmoura	SOUR	South	655
655	مزرعة بوسان العين	Mazraat Boustane El Aain	SOUR	South	655
655	مزرعة بوسان السيادة	Mazraat Byout El Siyad	SOUR	South	655
655	مزرعة بوسان	Mazraat Bsaileh	SOUR	South	655
655	مزرعة دير حنا	Mazraat Deir Hanna	SOUR	South	655
655	مزرعة البياضة	Mazraat el Biyada	SOUR	South	655
655	مزرعة الخرايبه	Mazraat EL Khraibeh	SOUR	South	655
655	مزرعة جبال البحر	Mazraat Jal EL Bahr	SOUR	South	655

# ANNEX B

## LIST OF METEOROLOGICAL STATIONS

<i>Station Name</i>	<i>Altitude</i>	<i>Mouhafaza</i>	<i>Caza</i>
BEYROUTH-GOLF	14	<i>Beirut</i>	Beirut
HOUCH-EL-OUMARA_ZAHLE	926	<i>Bekaa</i>	Zahle
DAHR EL BAIDAR	1516	<i>Bekaa</i>	Zahle
AL ARZ-LES CEDRES	1891	<i>North</i>	Bcharre
RAYAK- AMARA	852	<i>Bekaa</i>	Zahle
EL ABDE	37	<i>North</i>	Akkar
SOUR	4	<i>South</i>	Sour
ZAHRANI	10	<i>South</i>	Saida
EL QLAIAT-AKKAR	5	<i>North</i>	Akkar
EL QOUBAYAT	497	<i>North</i>	Akkar
QARTABA	1222	<i>Mount Lebanon</i>	Jbeil
EL QOUSSAIBAH-Ksaibe	584	<i>Mount Lebanon</i>	Baabda
BAYSSOUR	940	<i>Mount Lebanon</i>	Aley
JEZZIN	1070	<i>South</i>	Jezzine
FAQRA	1655	<i>Mount Lebanon</i>	Kesrouan
EL HERMEL	605	<i>Bekaa</i>	Hermel
DEIR-EL-AHMAR	943	<i>Bekaa</i>	Baalbek
EL QARAOUN-BARRAGE	843	<i>Bekaa</i>	West Bekaa
MARJAYOUN	827	<i>Nabatiye</i>	Marjayoun
TRIPOLI- BOUEE	0	<i>North</i>	Tripoli
ZAHRANI- BOUEE	0	<i>South</i>	Saida
BEYROUTH- BOUEE	0	<i>Beirut</i>	Beirut
BALAMAND	359	<i>North</i>	Koura
SYR-ED-DENNIYE	926	<i>North</i>	Minieh-Dinnieh
KAFAR CHAKHNA	260	<i>North</i>	Zgharta
KASLIK JOUNIEH	41	<i>Mount Lebanon</i>	Kesrouan
DEIR-EL-KAMAR	794	<i>Mount Lebanon</i>	Chouf
BAROUK FRAIDIS	1114	<i>Mount Lebanon</i>	Chouf
SAIDA	14	<i>South</i>	Saida
LEBAA	331	<i>South</i>	Jezzine
EL QUASMIYE	9	<i>South</i>	Sour
EL_QAA	513	<i>Bekaa</i>	Hermel
KAFAR QOUQ / RACHAYA	1205	<i>Bekaa</i>	Rachaya
TANNOURINE	1838	<i>North</i>	Batroun
KAFAR DOUNINE	560	<i>Nabatiye</i>	Bent Jbeil
EL MESHREF	395	<i>Mount Lebanon</i>	Chouf
Beirut International Airport	12.3	<i>Mount Lebanon</i>	Baabda
TRIPOLI_IPC	5	<i>North</i>	Tripoli
HEMLAYA	805	<i>Mount Lebanon</i>	Metn
DOURIS	1009	<i>Bekaa</i>	Baalbek



# ANNEX C

## POTABLE WATER STANDARDS DECREE 1039/1999:161

### 1. Chemical & Physical properties for Potable (drinking water) - Max concentration

Chemical name - Chemical symbol	Max allowed concentration (mg/L)
Chlorine (CL <sub>2</sub> )	0.3
pH value	5.6 – 5.8
Total dissolved solids (TDS)	500
Copper - cu	1
Iron - Fe	0.3
Magnesium - Mg	50
Manganese - Mn	0.05
Sulfates - SO <sub>4</sub>	250
Zinc - Zn	5
Calcium as CaCO <sub>3</sub>	200
Chlorides - CL	200
Total Hardness as CaCO <sub>3</sub>	250
Phenolic compounds as Phenol except natural Phenols that do not react with Chlore	0.001
Mineral oils	None
Chloroform extract on coal (carbon)	5.0
Effective surface factors (Kipritonat Alkyl-Benzene)	none
Ammonia	none
Phosphate - P <sub>2</sub> O <sub>5</sub>	1
Organic material	5.0
Nitrite - NO <sub>2</sub>	0.05
Hydrogen Sulfide H <sub>2</sub> S	0.05
Nitrate - NO <sub>3</sub>	5
Sodium - Na	150
Potassium - K	12
Aluminum - Al	0.2
Arsenic - As	0.05
Cadmium - Cd	0.005
Cyanide - Cn	0.05
Mercury - Hg	0.001
Selenium - Se	0.01
Lead - Pb	0.01
Hexavalent chromium - Cr	0.05
Barium - Ba	0.5
Silver - Ag	0.01
Nickel - Ni	0.02



Aromatic Hydrocarbons:	
Fluoranthene	0.0002
3.4 Benzflorantin	0.0002 & 0.0002
11.12 Benzflorantin	0.0001 combined
3.4 Benzopyrene	0.0001
1.12 Benzpirilin	0.0002
Alandino (1, 2.3, c, d) pyrene	0.0002
Fluoride between 8 & 12 deg C	1.5
25 & 30 deg C	0.7
Halogenated organic compounds	0.06
Chloroform	0.1
Dieldrin	0.00002
Lindane	0.0002
Methoxy Chlor	0.02
Toxaphene	0.003
2.4 binary acid summarize Klorvinnox	0.03
2 (2, 4.5) tri Klorvinnox	0.009

## 2. Microbial properties in drinking water

Characteristics	Max allowed
Total Coliforms	0 in 100 mm
Streptococcus faecalis	0 in 250 mm
Anaerobies sporules – Sporulaed sulphite / reducing anaerobes	0 in 50 mm
Feacal colifrm	0 in 250 mm
Esherichia coli	0 in 250 mm
Pseudomonas aeruginosa	0 in 250 mm
The total number of microorganisms at temperatures 22 degree for 72 hours	100 in 1mm
37 degree for 24 hours	20 in 1 mm

# ANNEX D

## WATER DEMAND CATEGORIZATION

DEMAND TYPE	CATEGORY	USE TYPE	PLANTS	IRRIG. TYPE	USE MODE	APPLICATION	PLUMBING	CONSUMPTION	UNITS
Drinking, Cooking Residential	USECAT1	NA	NA	NA	NA	NA	NA	3	l/p/d
Domestic Normal Residential	USECAT2	DOMESTIC	NA	NA	NORMAL	RESIDENTIAL	NA	140	l/p/d
Domestic Saving Residential	USECAT2	DOMESTIC	NA	NA	SAVING	RESIDENTIAL	NA	85	l/p/d
Domestic Normal Hospital	USECAT2	DOMESTIC	NA	NA	NORMAL	HOSPITAL	NA	70	l/p/d
Domestic Saving Hospital	USECAT2	DOMESTIC	NA	NA	SAVING	HOSPITAL	NA	45	l/p/d
Domestic Normal Hotel	USECAT2	DOMESTIC	NA	NA	NORMAL	HOTEL	NA	100	l/p/d
Domestic Saving Hotel	USECAT2	DOMESTIC	NA	NA	SAVING	HOTEL	NA	70	l/p/d
Domestic Normal School	USECAT2	DOMESTIC	NA	NA	NORMAL	SCHOOL	NA	20	l/p/d
Domestic Saving School	USECAT2	DOMESTIC	NA	NA	SAVING	SCHOOL	NA	15	l/p/d
Domestic Normal Jail	USECAT2	DOMESTIC	NA	NA	NORMAL	JAIL	NA	50	l/p/d
Domestic Saving Jail	USECAT2	DOMESTIC	NA	NA	SAVING	JAIL	NA	35	l/p/d
Domestic Normal Office Building	USECAT2	DOMESTIC	NA	NA	NORMAL	OFFICE BLDG	NA	15	l/p/d
Domestic Saving Office Building	USECAT2	DOMESTIC	NA	NA	SAVING	OFFICE BLDG	NA	10	l/p/d
Domestic Normal Public Building	USECAT2	DOMESTIC	NA	NA	NORMAL	PUBLIC BLDG	NA	3	l/p/d
Domestic Saving Public Building	USECAT2	DOMESTIC	NA	NA	SAVING	PUBLIC BLDG	NA	2	l/p/d
Domestic Car Wash	USECAT2	CAR WASH	NA	NA	NA	NA	NA	30	l/cw/m
Irrigation Hose Green Lawn	USECAT2	IRRIGATION	GREEN LAWN	HOSE	NA	NA	NA	9	l/m <sup>2</sup> /d
Irrigation Sprinkler Green Lawn	USECAT2	IRRIGATION	GREEN LAWN	SPRINKLER	NA	NA	NA	7	l/m <sup>2</sup> /d
Irrigation Sprinkler Green Lawn	USECAT2	IRRIGATION	GREEN LAWN	SUB-SURFACE	NA	NA	NA	5	l/m <sup>2</sup> /d
Irrigation Hose Shrubbery & Trees	USECAT2	IRRIGATION	SHRUBBERY	HOSE	NA	NA	NA	3	l/s/d
Irrigation Hose Shrubbery & Trees	USECAT2	IRRIGATION	SHRUBBERY	DRIP	NA	NA	NA	1.5	l/s/d
Irrigation Hose Shrubbery & Trees	USECAT2	IRRIGATION	SHRUBBERY	SUB-SURFACE	NA	NA	NA	1	l/s/d
Laundry, WC Normal, Residential	USECAT3	DOMESTIC	NA	NA	NORMAL	RESIDENTIAL	PLUMBING 2CL	40	l/p/d
Laundry, WC Saving Residential	USECAT3	DOMESTIC	NA	NA	SAVING	RESIDENTIAL	PLUMBING 2CL	26	l/p/d
Laundry, WC Normal, Hospital	USECAT3	DOMESTIC	NA	NA	NORMAL	HOSPITAL	PLUMBING 2CL	50	l/p/d
Laundry, WC Saving Hospital	USECAT3	DOMESTIC	NA	NA	SAVING	HOSPITAL	PLUMBING 2CL	35	l/p/d
Laundry, WC Normal, Hotel	USECAT3	DOMESTIC	NA	NA	NORMAL	HOTEL	PLUMBING 2CL	50	l/p/d
Laundry, WC Saving Hotel	USECAT3	DOMESTIC	NA	NA	SAVING	HOTEL	PLUMBING 2CL	35	l/p/d
WC Normal, School	USECAT3	DOMESTIC	NA	NA	NORMAL	SCHOOL	PLUMBING 2CL	5	l/p/d
WC Saving School	USECAT3	DOMESTIC	NA	NA	SAVING	SCHOOL	PLUMBING 2CL	3	l/p/d
Laundry, WC Normal, Jail	USECAT3	DOMESTIC	NA	NA	NORMAL	JAIL	PLUMBING 2CL	30	l/p/d
Laundry, WC Saving Jail	USECAT3	DOMESTIC	NA	NA	SAVING	JAIL	PLUMBING 2CL	20	l/p/d
WC Normal, Office Building	USECAT3	DOMESTIC	NA	NA	NORMAL	OFFICE BLDG	PLUMBING 2CL	10	l/p/d
WC Saving Office Building	USECAT3	DOMESTIC	NA	NA	SAVING	OFFICE BLDG	PLUMBING 2CL	7	l/p/d
WC Normal, Public Building	USECAT3	DOMESTIC	NA	NA	NORMAL	PUBLIC BLDG	PLUMBING 2CL	3	l/p/d
WC Saving Public Building	USECAT3	DOMESTIC	NA	NA	SAVING	PUBLIC BLDG	PLUMBING 2CL	2	l/p/d
Irrigation Sprinkler Green Lawn	USECAT3	IRRIGATION	GREEN LAWN	SUB-SURFACE	NA	NA	NA	5	l/m <sup>2</sup> /d
Irrigation Drip Shrubbery and Trees	USECAT3	IRRIGATION	SHRUBBERY	DRIP	NA	NA	NA	1.5	l/s/d

WATER DEMAND CATEGORIZATION (CONT'D)

DEMAND TYPE	CATEGORY	USE TYPE	PLANTS	IRRIG. TYPE	USE MODE	APPLICATION	PLUMBING	CONSUMPTION	UNITS
Irrigation Drip Shrubby and Trees	USECAT3	IRRIGATION	SHRUBBERY	SUB-SURFACE	NA	NA	NA		
WC Normal, Residential	USECAT3	DOMESTIC	NA	NA	NORMAL	RESIDENTIAL	PLUMBING 2C1	20	l/p/d
WC Saving Residential	USECAT3	DOMESTIC	NA	NA	SAVING	RESIDENTIAL	PLUMBING 2C1	15	l/p/d
WC Normal, Hospital	USECAT3	DOMESTIC	NA	NA	NORMAL	HOSPITAL	PLUMBING 2C1	20	l/p/d
WC Saving Hospital	USECAT3	DOMESTIC	NA	NA	SAVING	HOSPITAL	PLUMBING 2C1	15	l/p/d
WC Normal, Hotel	USECAT3	DOMESTIC	NA	NA	NORMAL	HOTEL	PLUMBING 2C1	20	l/p/d
WC Saving Hotel	USECAT3	DOMESTIC	NA	NA	SAVING	HOTEL	PLUMBING 2C1	15	l/p/d
WC Normal, School	USECAT3	DOMESTIC	NA	NA	NORMAL	SCHOOL	PLUMBING 2C1	85	l/p/d
WC Saving School	USECAT3	DOMESTIC	NA	NA	SAVING	SCHOOL	PLUMBING 2C1	70	l/p/d
WC Normal, Jail	USECAT3	DOMESTIC	NA	NA	NORMAL	JAIL	PLUMBING 2C1	15	l/p/d
WC Saving Jail	USECAT3	DOMESTIC	NA	NA	SAVING	JAIL	PLUMBING 2C1	8	l/p/d
WC Normal, Office Building	USECAT3	DOMESTIC	NA	NA	NORMAL	OFFICE BLDG	PLUMBING 2C1	70	l/p/d
WC Saving Office Building	USECAT3	DOMESTIC	NA	NA	SAVING	OFFICE BLDG	PLUMBING 2C1	20	l/p/d
WC Normal, Public Building	USECAT3	DOMESTIC	NA	NA	NORMAL	PUBLIC BLDG	PLUMBING 2C1	15	l/p/d
WC Saving Public Building	USECAT3	DOMESTIC	NA	NA	SAVING	PUBLIC BLDG	PLUMBING 2C1	50	l/p/d
Laundry, Normal, Residential	USECAT3	DOMESTIC	NA	NA	NORMAL	RESIDENTIAL	PLUMBING 2L	20	l/p/d
Laundry, Saving Residential	USECAT3	DOMESTIC	NA	NA	SAVING	RESIDENTIAL	PLUMBING 2L	11	l/p/d
Laundry, Normal, Hospital	USECAT3	DOMESTIC	NA	NA	NORMAL	HOSPITAL	PLUMBING 2L	30	l/p/d
Laundry, Saving Hospital	USECAT3	DOMESTIC	NA	NA	SAVING	HOSPITAL	PLUMBING 2L	20	l/p/d
Laundry, Normal, Hotel	USECAT3	DOMESTIC	NA	NA	NORMAL	HOTEL	PLUMBING 2L	30	l/p/d
Laundry, Saving Hotel	USECAT3	DOMESTIC	NA	NA	SAVING	HOTEL	PLUMBING 2L	20	l/p/d
Laundry, Normal, Jail	USECAT3	DOMESTIC	NA	NA	NORMAL	JAIL	PLUMBING 2L	15	l/p/d
Laundry, Saving Jail	USECAT3	DOMESTIC	NA	NA	SAVING	JAIL	PLUMBING 2L	12	l/p/d
WC Normal, Residential	USECAT4	DOMESTIC	NA	NA	NORMAL	RESIDENTIAL	PLUMBING 2C2	20	l/p/d
WC Saving Residential	USECAT4	DOMESTIC	NA	NA	SAVING	RESIDENTIAL	PLUMBING 2C2	15	l/p/d
WC Normal, Hospital	USECAT4	DOMESTIC	NA	NA	NORMAL	HOSPITAL	PLUMBING 2C2	20	l/p/d
WC Saving Hospital	USECAT4	DOMESTIC	NA	NA	SAVING	HOSPITAL	PLUMBING 2C2	15	l/p/d
WC Normal, Hotel	USECAT4	DOMESTIC	NA	NA	NORMAL	HOTEL	PLUMBING 2C2	20	l/p/d
WC Saving Hotel	USECAT4	DOMESTIC	NA	NA	SAVING	HOTEL	PLUMBING 2C2	15	l/p/d
WC Normal, School	USECAT4	DOMESTIC	NA	NA	NORMAL	SCHOOL	PLUMBING 2C2	5	l/p/d
WC Saving School	USECAT4	DOMESTIC	NA	NA	SAVING	SCHOOL	PLUMBING 2C2	3	l/p/d
WC Normal, Jail	USECAT4	DOMESTIC	NA	NA	NORMAL	JAIL	PLUMBING 2C2	15	l/p/d
WC Saving Jail	USECAT4	DOMESTIC	NA	NA	SAVING	JAIL	PLUMBING 2C2	8	l/p/d
WC Normal, Office Building	USECAT4	DOMESTIC	NA	NA	NORMAL	OFFICE BLDG	PLUMBING 2C2	10	l/p/d
WC Saving Office Building	USECAT4	DOMESTIC	NA	NA	SAVING	OFFICE BLDG	PLUMBING 2C2	7	l/p/d
WC Normal, Public Building	USECAT4	DOMESTIC	NA	NA	NORMAL	PUBLIC BLDG	PLUMBING 2C2	3	l/p/d
WC Saving Public Building	USECAT4	DOMESTIC	NA	NA	SAVING	PUBLIC BLDG	PLUMBING 2C2	2	l/p/d
Irrig. BG Green Lawn	USECAT4	IRRIGATION	GREEN LAWN	SUB SURFACE	NA	NA	NA	5	l/m <sup>2</sup> /d
Irrig. BG Shrubby and Trees	USECAT4	IRRIGATION	SHRUBBERY	SUB SURFACE	NA	NA	NA	1	l/s/d

# ANNEX E

## PIPE SIZES AND FRICTION FACTORS

Q (m <sup>3</sup> /hr)	PPR SCHED 20		PEX SCHED 20		GSP SCHED 40	
	DN (mm)	hf	DN (mm)	hf	DN (inch)	hf
0.1	20	0.0075	20	0.0042	1/2	0.0022
0.2	20	0.0306	20	0.0201	1/2	0.0129
0.3	20	0.0625	20	0.0409	1/2	0.0266
0.4	20	0.1045	20	0.0683	1/2	0.0448
0.5	20	0.1565	20	0.1020	1/2	0.0675
0.6	20	0.2183	20	0.1420	1/2	0.0945
0.7	20	0.2897	20	0.1882	1/2	0.1259
0.8	20	0.3708	20	0.2404	1/2	0.1617
0.9	20	0.4614	20	0.2988	1/2	0.2018
1	20	0.5615	20	0.3632	1/2	0.2462
1.1	20	0.6711	20	0.4337	1/2	0.2949
1.2	20	0.7902	25	0.1676	1/2	0.3480
1.3	25	0.2907	25	0.1942	1/2	0.4054
1.4	25	0.3337	25	0.2228	1/2	0.4670
1.5	25	0.3795	25	0.2532	3/4	0.1331
1.6	25	0.4281	25	0.2854	3/4	0.1503
1.7	25	0.4796	25	0.3196	3/4	0.1686
1.8	32	0.1572	25	0.3556	3/4	0.1879
1.9	32	0.1737	25	0.3934	3/4	0.2082
2	32	0.1911	25	0.4331	3/4	0.1913
2.1	32	0.2092	25	0.4747	3/4	0.2519
2.2	32	0.2281	32	0.1456	3/4	0.2753
2.3	32	0.2478	32	0.1581	3/4	0.2997
2.4	32	0.2683	32	0.1711	3/4	0.3251
2.5	32	0.2896	32	0.1846	3/4	0.3515
2.6	32	0.3117	32	0.1986	3/4	0.3790
2.7	32	0.3345	32	0.2130	3/4	0.4075
2.8	32	0.3582	32	0.2280	3/4	0.4370
2.9	32	0.3826	32	0.2435	3/4	0.4675
3	32	0.4078	32	0.2594	3/4	0.4991
3.1	32	0.4338	32	0.2758	1	0.1469
3.2	32	0.4605	32	0.2928	1	0.1561
3.3	32	0.4881	32	0.3102	1	0.1655
3.4	40	0.1655	32	0.3281	1	0.1752
3.5	40	0.1747	32	0.3465	1	0.1851

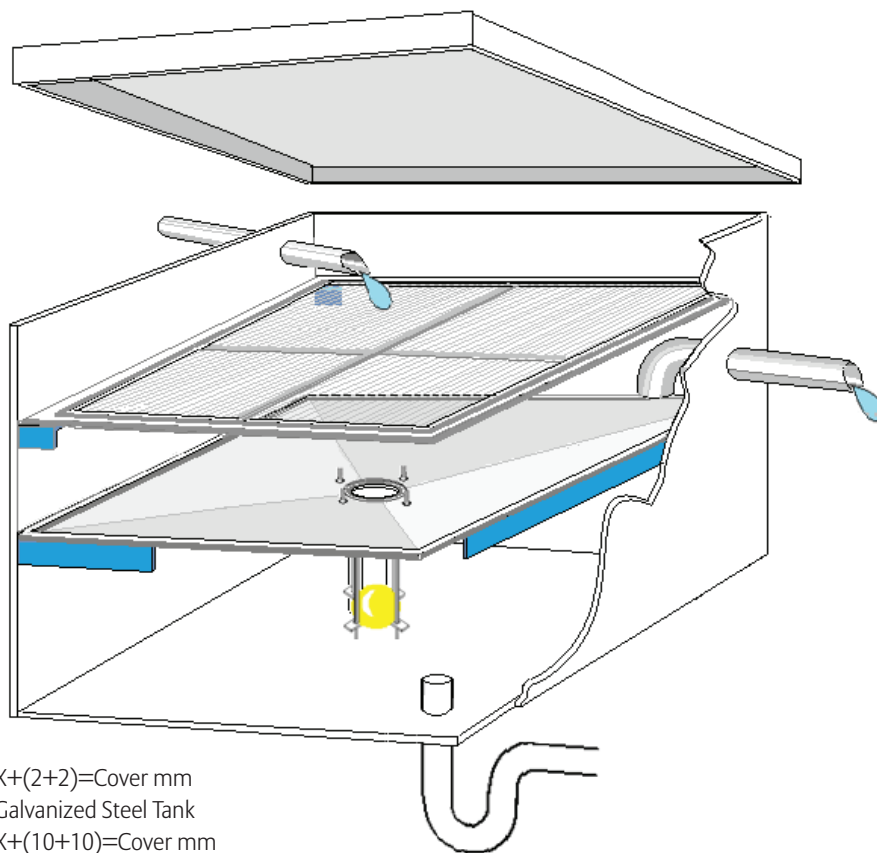


## PIPE SIZES AND FRICTION FACTORS (CONT'D)

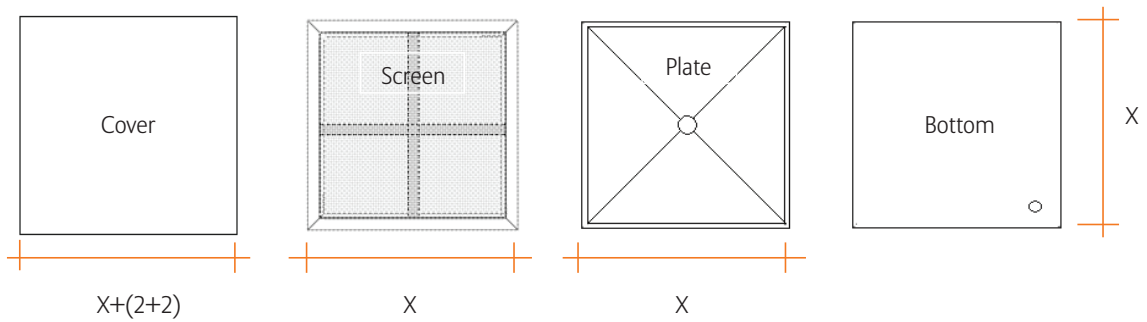
Q (m <sup>3</sup> /hr)	PPR SCHED 20		PEX SCHED 20		GSP SCHED 40	
	DN (mm)	hf	DN (mm)	hf	DN (inch)	hf
3.6	40	0.1841	32	0.3653	1	0.1954
3.7	40	0.1938	32	0.3847	1	0.2059
3.8	40	0.2037	32	0.4045	1	0.2166
3.9	40	0.2138	32	0.4249	1	0.2277
4	40	0.2242	32	0.4457	1	0.2390
4.1	40	0.2349	32	0.4670	1	0.2506
4.2	40	0.2457	32	0.4888	1	0.2624
4.3	40	0.2568	40	0.1667	1	0.2746
4.4	40	0.2682	40	0.1740	1	0.2870
4.5	40	0.2797	40	0.1815	1	0.2996
4.6	40	0.2916	40	0.1891	1	0.3126
4.7	40	0.3036	40	0.1969	1	0.3258
4.8	40	0.3159	40	0.2048	1	0.3393
4.9	40	0.3284	40	0.2129	1	0.3530
5	40	0.3412	40	0.2211	1	0.3670
5.1	40	0.3542	40	0.2295	1	0.3813
5.2	40	0.3674	40	0.2380	1	0.3959
5.3	40	0.3809	40	0.2467	1	0.4107
5.4	40	0.3946	40	0.2556	1 1/4	0.1129
5.5	40	0.4086	40	0.2646	1 1/4	0.1169
5.6	40	0.4228	40	0.2737	1 1/4	0.1210
5.7	40	0.4372	40	0.2830	1 1/4	0.1252
5.8	40	0.4519	40	0.2924	1 1/4	0.1294
5.9	40	0.4668	40	0.3020	1 1/4	0.1337
6	40	0.4819	40	0.3118	1 1/4	0.1381
6.1	40	0.4973	40	0.3216	1 1/4	0.1425
6.2	50	0.1633	40	0.3317	1 1/4	0.1470
6.3	50	0.1682	40	0.3419	1 1/4	0.1516
6.4	50	0.1733	40	0.3522	1 1/4	0.1562
6.5	50	0.1784	40	0.3627	1 1/4	0.1609
6.6	50	0.1836	40	0.3734	1 1/4	0.1657
6.7	50	0.1889	40	0.3842	1 1/4	0.1706
6.8	50	0.1942	40	0.3951	1 1/4	0.1755
6.9	50	0.1996	40	0.4062	1 1/4	0.1805
7	50	0.2051	40	0.4174	1 1/4	0.1855

# ANNEX F

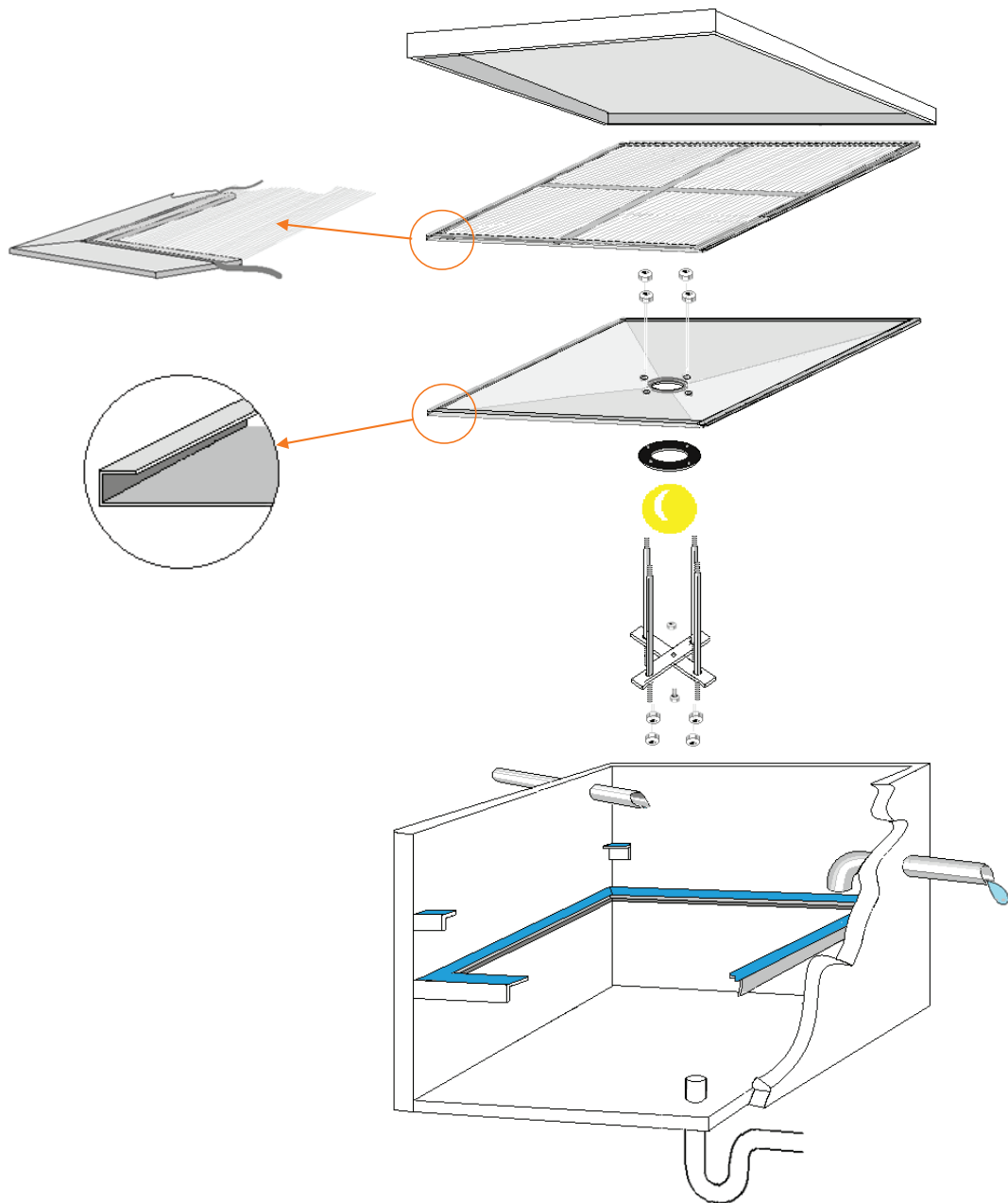
## FIRST FLUSH TANK DETAILS



$X+(2+2)=\text{Cover mm}$   
Galvanized Steel Tank  
 $X+(10+10)=\text{Cover mm}$   
Concrete Tank



## FIRST FLUSH TANK DETAIL (CONT'D)



# ANNEX G

## PRICING ESTIMATES OF SYSTEM COMPONENTS

AS PER DATE; July 2014

**Table 1.** Storage Tank Material Pricing (July 2014)

Material	Size / Liters	Price \$
Concrete	18000	4000
	40000	6500
<b>PE Above Ground</b>		
Single layer Tanks	300	66
	2000	209
Large Capacity Tanks	22000	2750
Triple Layer Tanks	80	52
	500	117
	2000	347
<b>PE Under Ground</b>		
Tanks	6000	1296
	10000	2145
Modular	19000	6600
<i>PE with RWH System*</i>	4500	3100
Stainless Steel	200	750

Assumptions; Consumption: 2m<sup>2</sup>/p/d  
Concrete price: 1m<sup>3</sup>=250\$

RWH System: PE Tank with several chambers within, to include water treatment, of a certain size.  
(NOT INCLUDED WITHIN THIS STUDY)

**Table 2.** Drains Pricing (July 2014)

Roof Drains	Specifications	Price \$
Roof drain (Dome Type)	- PP	70
	- Outlet types: side/bottom	
	- Dome cover – prevent large debris	
	- Linked to normal piping	
Roof Double drain (Tower Type)	- PP	90
	- outlet types: side/bottom	
	- Double drainage	
	- Gravel guard	
	- Linked to normal piping	



## PRICING ESTIMATES OF SYSTEM COMPONENTS (CONT'D)




**Table 3. Gutters/Downspouts Pricing (July 2014)**

Piping	Material	Price \$/m
Gutters	PVC rain gutters – 174mm diam.	8.5
	Additional Components	8.5
Down Risers	PVC – 4" pipe with 4.3mm thickness	6

**Table 4. Piping Pricing (July 2014)**

Piping	Source	Price \$/4 or \$/6m					
		20mm	25mm	32mm	40mm	50mm	
PPR							
4m long pipe	Turkish	3.3	4.3	8.0	12.0	18.0	
4m long pipe	German	6.5	10.0	16.0	26.0	40.0	
Galvanized Steel		1/2in	3/4in	1in	1 1/4in	1 1/2in	2in
6m long pipe	Turkish	14.0	19.0	30.0	37.0	44.0	60.0

**Table 5. Pumps Pricing (July 2014)**

Pumps	Type	Price \$	Picture
<b>Horizontal</b>			
multistage pump	0.5 m <sup>3</sup> /h @ ≈30m W.G	370	
lift pump or booster pump	1 m <sup>3</sup> /h @ ≈30 m W.G	370	
	2 m <sup>3</sup> /h @ ≈30 m W.G	400	
	3 m <sup>3</sup> /h @ ≈30 m W.G	400	
	5 m <sup>3</sup> /h @ ≈30 m W.G	680	
<b>Vertical</b>			
multistage pump	2 m <sup>3</sup> /h @ ≈45 m W.G	1107	
lift pump or booster pump	3 m <sup>3</sup> /h @ ≈45 m W.G	1290	
Used when a high pressure is required	5 m <sup>3</sup> /h @ ≈45 m W.G	1290	
<b>Submersible</b>			
lifting pump to be installed inside tank (horizontal setup)	1 m <sup>3</sup> /h @ ≈30 m W.G	1537	
	2 m <sup>3</sup> /h @ ≈30 m W.G	1600	
	3 m <sup>3</sup> /h @ ≈30 m W.G	1600	
	5 m <sup>3</sup> /h @ ≈30 m W.G	1720	

PRICING ESTIMATES OF SYSTEM COMPONENTS (CONT'D)

**Table 6.** Carbon & Sedimentation Cartridge Pricing (July 2014)

Size	Carbon Cartridge		Sedimentation Cartridge			Body	
	5 micron	0.5 micron	5 micron	0.5 micron			
Source							
	US / EUR	Chinese	US / EUR	US / EUR	Chinese	US / EUR	
Price \$							
10 in	44	17	70	26	13	30	66
20 in	74	35	135	40	20	37	108

**Table 7.** Ultraviolet Light Pricing (July 2014)

Flow Rate	19 L/min (5gpm)	30 L/min (8gpm)	45 L/min (12gpm) - High flow
Price \$			
Device	600	750	950
Light Lamp	100	130	160

**Table 8.** Chlorination Dosing System Pricing (July 2014)

Size	Source	Price \$
2-40 m3 / day	Spanish 300	US 500

**Table 9.** Sand / Carbon Filter Pricing (July 2014)

Sizing according to flow rate	Sand Filter	Carbon Filter
Price \$		
10 gpm / sq ft	1100	1250

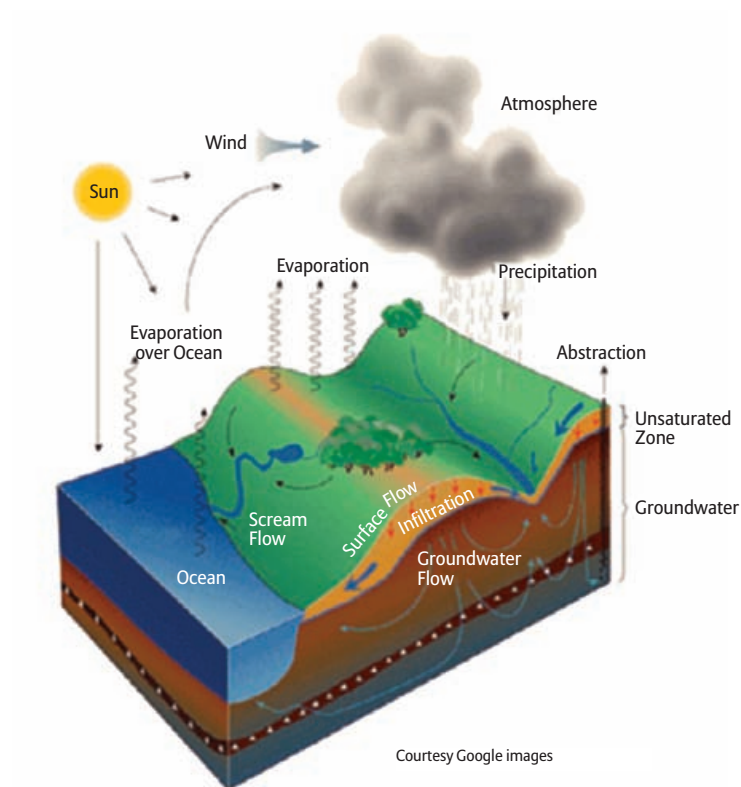
## ANNEX H

### THE CHEMICAL AND BACTERIOLOGICAL CHARACTERISTICS OF RAINWATER

Rainwater is the product of a distillation process which is inherent to the natural cycle of the water. Water evaporates from the ground, from water bodies, from plants, etc. and rises in the atmosphere as water vapor to form clouds which are the source of precipitations as rainfall and snow.

In theory rain should be pure water devoid of any chemicals or pollution before reaching the ground, but in practice this is not the case because rainwater collects on its way to the ground all kinds of chemicals and particles like dust, pollen, soot etc. present in the atmosphere.

Two major offending gases present in the atmosphere as a result of human and natural activities are the oxides of Nitrogen and Sulfur (respectively  $\text{NO}_x$  and  $\text{SO}_x$ ). Of course there are many others but these two gases greatly influence the acidity of the rainwater, a major chemical property that det water quality. Upon their dissolution in rainwater, nitrogen oxides gases form nitric acid and sulfur oxides gases form sulfuric acid. These are the culprits behind acid rains that wreck-havoc with forests around the world.



The Water Cycle

In Lebanon Sulfur dioxides result mainly from burning diesel and heavy fuel in industry, electricity power plants, transportation and the construction sector. Oxides of Nitrogen result mainly from the transport sector and to a lesser extent from the electricity production sector.

Dust, soot and other particles generated by human activities like industry, construction, traffic, etc. are also found in relatively high concentration in the atmosphere above urban and industrial centers. However a dusty atmosphere can result also from the easterly winds blowing from the Arabian Peninsula and across the Syrian inland. Many of us experienced the unpleasant sight of a recently washed car that was all muddied by first rains that carried the dust from the atmosphere and deposited it on our cars. Another major factor is the influence of the maritime environment; studies have shown that rain fall along coastal regions of the Mediterranean show a marked increase in chlorides, potassium, calcium, magnesium and Sodium.

Therefore we can safely say that there is a direct relation between air quality and rainwater quality. Consequently rainwater that falls over Beirut or the coastal region where the bulk of the economic activity is concentrated is surely of lesser quality than rainwater that falls at 800 meters altitude. This said, predominant winds could carry pollution far away, thus the low and mid altitudes of the western side of mount Lebanon range could suffer from pollutants generated on the coast and entrained by the dominant winds that blow West-South West.

However it is important to put things into perspective, rainwater that has not touched the ground even in Beirut has still way less chemicals than the purest spring water in Lebanon. Moreover, one study carried between October 2005 and April 2006 over 28 sites covering the Lebanese territory showed that the rainwater acidity varied between 6.6 and 7.7 which is an indication that acid rain is not an issue for Lebanon at least during the sampling period.

However once rainwater touches collection surfaces, then it is entirely a different ball game. Probabilities of bacteriological contamination are very high due to the presence of droppings, insects, rodents, etc. moreover chemical pollution may take a more serious turn if traces of heavy metals deposits are present on collection surfaces in industrial or heavily congested urban areas.

Therefore location specific collected rainwater quality is more related to collection surfaces which are to a far extent directly dependent on air quality and the exposure of such surfaces to

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## RAINWATER QUALITY IS LARGELY DEPENDENT ON AMBIENT AIR QUALITY AND GEOGRAPHICAL LOCATION.

biological pollution. Thus to give an example, areas of Beirut where pigeon communities are flourishing will invariably have rainwater collection surfaces with high biological contamination, indeed probably much higher than any area in the mountain where wild life is more flourishing. This will be also aggravated by probable deposits of traces of heavy metals due to combustion exhaust, aerosols, tires erosion, etc. The same could be said of all areas near heavily polluting industries (cement, carton, chemicals, etc.).

Further contamination and chemical loading may occur during the storage phase depending on the type of storage reservoirs and their cleanliness.



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# CASE STUDIES

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Though rainwater harvesting existed historically, it is not a commonly used system in Lebanon nowadays. Some individuals and institutions within the country have adopted rainwater harvesting practices for a variety of reasons, mainly due to weather changes, lack of rain and water scarcity. The following will cover examples of actual rainwater harvesting systems located in Lebanon, including why rainwater harvesting was chosen, design challenges and the benefits of utilizing rainwater harvesting on the site.

These cases do not reflect the best practices for RWH, treatment and use, but surely show the possible positive impact that rainwater collection would have on water supply & demand, water quality and the environment.

**CASE STUDY # 1**  
A PUBLIC SCHOOL

**CASE STUDY # 2**  
A MULTI-DISCIPLINARY CENTER

**CASE STUDY # 3**  
A PRIVATE SCHOOL

**CASE STUDY # 4**  
RESIDENTIAL BUILDING

**CASE STUDY # 5**  
SOS VILLAGE

# CASE STUDY # 1

## A PUBLIC SCHOOL

PROJECT:	ISKANDAR RIZK PUBLIC SCHOOL
LOCATION:	ACHKOUT – KASERWAN (CAZA) – MOUNT LEBANON (MOUHAFAZA)
ALTITUDE:	1000 m
APPLICATION:	STUDENTS TOILETS FLUSHING, TEACHERS TOILETS FAUCETS AND FLUSHING, CLEANING
SYSTEM:	2 ABOVEGROUND PE TANKS 22,000 X 2 = 44,000L TO CONTAIN THE RAINWATER, TREATMENT PLANT FOR DOMESTIC USE, 1 PE TANK = 22,000L TO CONTAIN THE TREATED WATER
CATCHMENT AREA:	EXTERNAL PLAYGROUND RARELY USED BY CHILDREN, CONCRETE FLOOR AREA OF 690 m <sup>2</sup>
COST:	15,000\$ (Tanks /Piping/ Pumps/ Treatment, civil work not included) <i>Note: Cost was affected in a positive way due to the system's being part of the whole project.</i>
DATE:	NOV. 2013 – MARCH 2014



**Sponsor:**  
HSBC (MENA  
competition for 4 public  
schools as part of an  
awareness campaign.)

**Client:**  
arcenciel

**Designer:**  
Sustainable  
Environmental Solutions  
- SES

The system was part of a complete water conservation and management plan for the school that serves 410 students with 40 teachers and staff members. The project includes waste water treatment plant and rainwater harvesting system. Water saving and rainwater use are the two main goals of the school to cover for the shortage in municipal water supply. The school, on the average, was always short of 50% of its need from municipal water. The rainwater harvesting covers the shortage and replaces the need to buy 3,000-4,000 liters / Week. 2 polyethylene tanks 22,000 liter each, were placed to store 44,000 liters of collected rainwater (22,000 x 2) that will be treated after collection to become good for domestic use and will be stored in a 22,000 liter PE tank. The collected water is used for toilet flushing, teachers' toilet wash basins and for cleaning the school.

On site, there was no problem in placing the RWH tanks. It had the perfect location area as to the whole project, for the waste treatment plant and for the rainwater harvesting system that was a dead unused space. This made the cost related to placement and connection as minimal. A reinforced concrete platform was constructed to insure well placement of tanks after excavations and leveling. Overflows of rainwater tanks were directed towards the forest nearby.

The system showed its success due to the amount of rainwater that was collected and used. The tanks are still full in the summer season, so the school will have no water shortage when school year starts in September especially that municipal water supply was cut in mid-summer season.

## CASE STUDY # 2

### A MULTI-DISCIPLINARY CENTER

PROJECT:	ARCENCIEL TAANAYEL CENTER - Nursery / Workshop / Restaurant
LOCATION:	TAANAYEL – ZAHLE (CAZA) – BEKAA (MOUHAFZA)
ALTITUDE:	830 m
APPLICATION:	TOILETS FLUSHING, FAUCETS AND CLEANING
SYSTEM:	2 ABOVEGROUND PE TANKS 22,000 X 2 = 44,000 L TO CONTAIN THE RAINWATER, TREATMENT PLANT FOR DOMESTIC USE, PUSH BUTTON FAUCETS IN TOILETS
CATCHMENT AREA:	CONCRETE ROOF, AREA OF 300 m <sup>2</sup>
COST:	25,000 \$ (Tanks/Piping/Pumps/Treatment/included civil work of roof)  <i>Note: Cost was affected negatively due to being one of the first projects implemented by the company, thus it was time consuming and had higher engineering cost.</i>
DATE:	2013



In response to the drought and as part of an ongoing effort towards a more sustainable location, the center built a rainwater collection system for domestic use and toilet flushing. With the growing shortage in municipal water supply and the continuous need to pump from the center's water well, the rainwater system was a need to the center that serves 300 persons. 2 polyethylene tanks 22,000 liter each, were placed to store 44,000 liters of collected rainwater (22,000 x 2), that would be treated after collection to become good for domestic use, after which water will be mixed with municipal water in the center's already existing tanks.

In winter, the rainy season, water well pumps and treatment plant would be turned off so to retain water volume in the well and help replenishing the water table to its normal natural levels. In summer season, when no more municipal water supply and water well level is low or no good (smelly), then, water treatment plant would be turned on. Nevertheless, the RWH system will be fully operational in the winter season to cover the shortage from the municipal water. This will result in lengthening the lifespan of the underground water, instead of using the underwater during the whole year they will use it only during summer season, thus resulting in better water quality with lower pollution concentration.

The system showed its success due to the amount of rainwater that was collected and used. The tanks are still half full in the summer season, end August.

**Sponsor:**  
Coca Cola Fund / UNDP

**Client:**  
arcenciel

**Designer:**  
Sustainable  
Environmental Solutions  
– SES

# CASE STUDY # 3

## A PRIVATE SCHOOL

PROJECT:	AVE MARIA SCHOOL
LOCATION:	ASIA – BATROUN (CAZA) - NORTH LEBANON (MOUHFAZA)
ALTITUDE:	800 m
APPLICATION:	TOILETS FLUSHING AND CLEANING
SYSTEM:	3 ABOVEGROUND PE TANKS 10,000 X 3 = 30,000 L TO CONTAIN THE RAINWATER
CATCHMENT AREA:	TILED ROOF, AREA OF 400 m <sup>2</sup>
COST:	10,000 \$ (Tanks/Piping/Pumps) <i>Note: Cost was affected negatively due to being the first project to be implemented.</i>
DATE:	NOV 2013 – MARCH 2014



Encouraged to take some action as a response to draught, the school wanted supplemental water to use for toilet flushing and cleaning. The school that serves 200 students with 30 teachers and staff members, already had an underground existing concrete tank of 70,000 liter supplied with municipal water. The 30,000 liters of harvested rainwater will only be screened from debris and leaves before being collected and mixed with municipal water. At the end of the project implementation, the school had a total volume of water storage equal to 100,000 liters.

Water is currently flowing over, so no water problem.

**Sponsor:**  
Coca Cola Fund / UNDP

**Client:**  
arcenciel

**Designer:**  
Sustainable  
Environmental Solutions  
– SES



## CASE STUDY # 4

### RESIDENTIAL BUILDING

PROJECT:	SARKIS BUILDING
LOCATION:	KENNABET BROUMANA – METN (CAZA) – MOUNT LEBANON (MUHAFAZA)
ALTITUDE:	450 m
APPLICATION:	ALL DOMESTIC USE AND IRRIGATION
SYSTEM:	REINFORCED CONCRETE TANK 40 m <sup>3</sup>
CATCHMENT AREA:	BRICK TILED SLOPED ROOF, 2 SURFACES 100 m <sup>2</sup> x 2 = 200 m <sup>2</sup>
COST:	MINIMAL - None
DATE:	1994



The building's design was a reflection of the owners' belief and awareness of environmental issues, water in particular. The rainwater harvesting system was part of the design of the building from its early stages. The building was not linked to municipal water due to multiple reasons one of which was the condition of municipal conveyance system. A 40 m<sup>3</sup> concrete tank was built on the basement level to store rainwater collected from 2 brick tiled sloped roofs as catchment surfaces of 200 m<sup>2</sup> area. This collected water is used by 4 families of around 20 people for all their domestic daily use and irrigation. No extra charge was needed due to the fact that it was the same charge accounted for the water conveyance system to be used. No special water treatment was implemented; only the addition of chlorine on regular basis is done, as disinfection.

Up until this year, water crisis year, the collected rainwater was being used from September till June of every year without any problem; about 9 to 10 months. Owners have future vision of exploiting an unused area of 140 m<sup>2</sup> flat roof with water treatment to be accounted for as well. They also have a belief in the importance of legislation and incentives in relation to the system's public spreading.

**Sponsor:**  
Private

**Client:**  
Sarkis Family

**Designer:**  
R.Sarkis Consultant

# CASE STUDY # 5

## SOS VILLAGE

PROJECT:	KFARHAY SOS VILLAGE
LOCATION:	KFARHAY – BATROUN (CAZA) - NORTH LEBANON (MOUHAFZA)
ALTITUDE:	400 m
APPLICATION:	IRRIGATION, TOILETS FLUSHING AND CLEANING
SYSTEM:	REHABILITATION (PIPING, PUMPS, SHOWER HEADS AND FAUCETS)
CATCHMENT AREA:	-----
COST:	3,500 \$ (Piping/Pumps)
DATE:	2014

The village design that was done by a German architect in mid-90's, which already incorporates rainwater harvesting tanks under all 10 houses from their roofs as catchment areas. Pumps pull water from house tanks to the main concrete tower which in itself is divided into 4 compartments for different water usage.

To keep the system working efficiently, rehabilitation was done to conveyance system and all leaking pipes and pumps were changed. This was part of a bigger project including a waste treatment plant and drop irrigation system. The collected rainwater will be added to the treated waste water and used for irrigation, toilet flushing and cleaning.

All shower heads, toilet faucets and kitchen faucets were changed as part of a complete water conservation and management plan.

**Sponsor:**  
HSBC

**Client:**  
SOS Villages

**Designer:**  
Sustainable  
Environmental Solutions  
- SES





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