

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION (CDR) and
MINISTRY OF ENERGY AND WATER (MEW)
THE REPUBLIC OF LEBANON

THE STUDY
ON
WATER RESOURCES MANAGEMENT MASTER PLAN
IN
THE REPUBLIC OF LEBANON

FINAL REPORT
SUPPORTING REPORT
Volume 1
GIS Database



January, 2004

SANYU CONSULTANTS INC.
YACHIYO ENGINEERING CO., LTD

2006.5.29
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1217509 [7]

**The Study
on Water Resources Management Master Plan
in the Republic of Lebanon**

GIS Database

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CHAPTER 1 OVERVIEW OF GIS DATABASE

1.1 Composition of Database

The GIS database consists of map data and attribute data, and is managed by ArcGIS (Software of GIS). The attribute data are divided in 3 databases, such as map attribute database, DBM (digital balancing model) database and observational database.

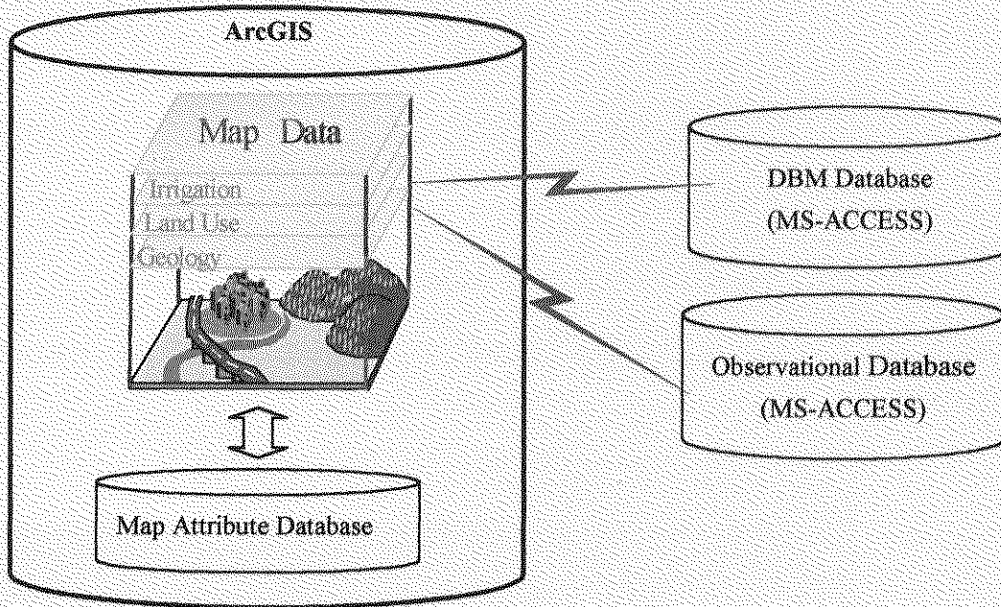


Figure 1.1-1 Image of Data Composition

1.2 Projection of Map Data

Map data is expressed two-dimensionally on paper or a computer. However, as the earth is an ellipse, it is necessary to apply the projection which distortion is minimum for latitudes.

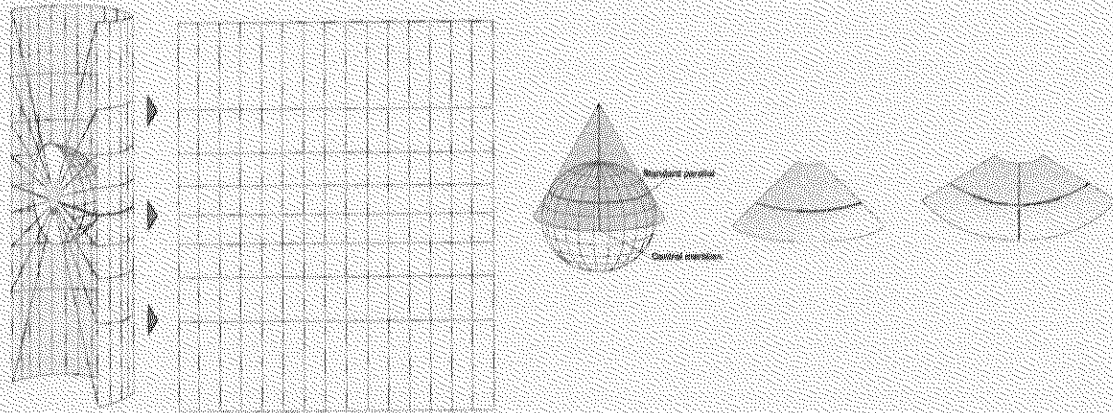


Figure 1.2-1 Example of Projective Method

Projection of the map is “Lambert Conformal Conic”. This projection is one of the best methods for middle latitudes.

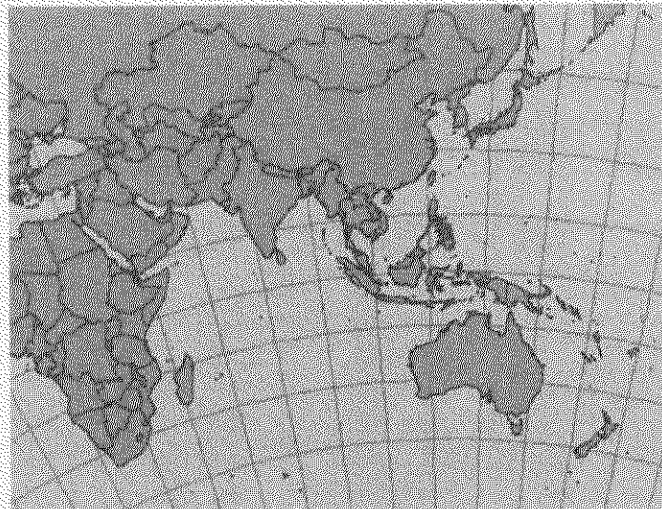


Figure 1.2-2 Scope of Lambert Conformal Conic

CHAPTER 2 STRUCTURE OF DATA

Data consist of 3 types, such as ArcGIS file format, Ms-Access file format, raster file format (scanned data).

2.1 ArcGIS Data

GIS data has the layered structure, which each layer is composed of several files. These files are stored in a given folder.

Table 2.1-1 Folder Structure of ArcGIS Data (1/2)

Main Folder Name	Sub Folder Name	Layer Name	
WRML	Admin	Border	
		Caza	
		Mohafaza	
		NewWaterAuthority	
		Town	
		WaterAuthority	
		WaterSupplyZoning	
	Background	Tiles	
	DBM	DemandArea	
		SupplyArea	
	Geography	Barycenter	
		Base	
		Contours	
		Fault	
		Geology	
		Hydrogeology	
		Lake	
		Landuse1995	
		LandUse2000	
		pointent250	
		River	
		SubBasin	
		WatershedArea	
	Infrastructure	Dam	
		Road	
	WRML	Infrastructure	WastewaterPlant
			WaterSourceTransmission
WaterTreatmentPlant			
Irrigation		Climate	
		Irrigation	
Observation		Hydro	
		Meteoro	
Survey		FS_river	
		FS_sea	
		FS_spring	
WaterQuality		WQ_Groundwater	
		WQ_IndWasteWater	
		WQ_Litani	

Table 2.1-1 Folder Structure of ArcGIS Data (2/2)

Main Folder Name	Sub Folder Name	Layer Name
WRML	WaterQuality	WQ MuniWasteWater
		WQ Qaraaoun
		WQ SeaWater
	WaterResource	Borehole
		Spring
		Well

2.2 Ms-Access Data

DBM database and Observational data database are in the access file format. DBM database stores default value, input data and output data. Observational data database stores daily discharge, daily rainfall, and monthly meteorological data.

Table 2.2-1 Folder Structure of Ms-Access Data

Main Folder Name	Sub Folder Name	File Name
WRML	Database	DBM.mdb
		ObservationalData.mdb

2.3 Raster Data

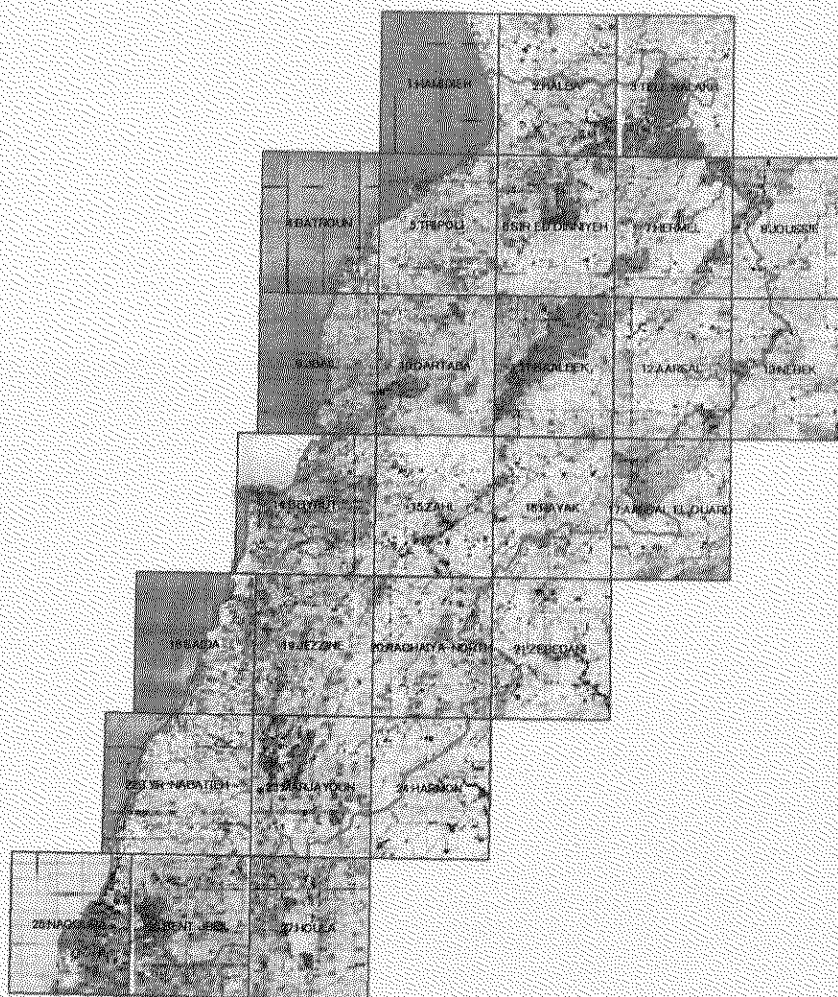
Raster data of topographic maps (27 sheets 1:50,000) and satellite map (1 sheet 1:200,000) scanned are prepared. The file format is TIFF or JPEG corrected geometrically. The paper topographic map composed of 27 sheets prepared by the Direction of Affaires Geography, Ministry of Defense.

Table 2.3-1 Folder Structure of Raster Data (1/2)

Main Folder Name	Sub Folder Name	File Name	Map Name	Prepared Date
WRML	Background	1.tif	HAMIDIEH	Jul/1960
		2.tif	HALBA	1933
		3.tif	TELL KALAKH	1945
		4.tif	BATROUN	Aug/1962
		5.tif	TRIPOLI	Aug/1962
		6.tif	SIR ED DINNIYEH	1940
		7.tif	HERMEL	Oct/1961
		8.tif	JOUSSIE	Oct/1961
		9.tif	JEBAIL	1940
		10.tif	QARTABA	Sep/1962
		11.tif	BAALBEK	May/1960
		12.tif	AARSAL	1945
		13.tif	NEBEK	Oct/1961
		14.tif	BEIYRUT	Mar/1960
		15.tif	ZAHL	1939
		16.tif	RAYAK	1939

Table 2.3-1 Folder Structure of Raster Data (2/2)

Main Folder Name	Sub Folder Name	File Name	Map Name	Prepared Date
WRML	Background	17.tif	AASSAL EL OUARD	Apr/1961
		18.tif	SAIDA	1945
		19.tif	JEZZINE	1940
		20.tif	RACHAIYA-NORD	1940
		21.tif	ZEBEDANI	1929
		22.tif	TYR-NABATIEH	Sep/1962
		23.tif	MARJAYOUN	1964
		24.tif	HERMON	1941
		25.tif	NAQOURA	May/1960
		26.tif	BENT JBEIL	1959
		27.tif	HOULA	1961
		Satellite.jpg	Landsat, IRS	-



Appendix 1

Definition of Maps and Attribute Data

Map Data List

No	Map (Layer) Name	Type	Source	Description
1	Border	Polygon	Prepared by JICA study team from Boundary map of ArcLeb	National boundary of Lebanon
2	Caza	Polygon	Prepared by JICA study team from Kadaa map of ArcLeb	Boundary of Caza
3	Mohafaza	Polygon	Prepared by JICA study team from Mohafaza map of ArcLeb	Boundary of Mohafaza
4	NewWaterAuthority	Polygon	Prepared by JICA study team from Caza map	Boundary of new water authority
5	Town	Point	Prepared by JICA study team from Population map of ArcLeb	Position of town or village <category> 1:Capital of Mohafaza 2:Capital of Caza 0:Others
6	WaterAuthority	Polygon	Prepared by JICA study team from Ministry of Energy and Water	Boundary of water authority
7	WaterSupplyZoning	Polygon	Prepared by JICA study team from NERP yr 2/3 Feasibilities Studies and Environmental Assessment Reports - Water Supply Sector (Volumes of Central, North, South, Bekka), Haward Hamphry, 1995	Boundary of water supply system
8	Tiles	Polygon	Prepared by JICA study team from topographic map (1:50,000)	Boundary of paper topographic map (1/50,000)
9	DemandArea	Polygon	Prepared by JICA study team from Caza and Water Authority maps	Boundary of demand area. Demand area is Caza area, but Beirut, suburb of Beirut and Saida are water authority area.
10	SupplyArea	Polygon	Prepared by JICA study team from Watershed Area map	Boundary of watershed
11	Barycenter	Point	Prepared by JICA study team from Sub-Basin map	Calculation point of SSM
12	Base	Polygon	Prepared by JICA study team	Formwork of Lebanon
13	Contours	Line	Prepared by JICA study team from Contours map of ArcLeb	Line of contour at intervals of 50 meters
14	Fault	Line	Prepared by JICA study team from satellite map (Landsat and IRS)	Line of fault
15	Geology	Polygon	Prepared by JICA study team from geology map in 1955 by Ministry of Public Works (1/200,000)	Boundary of geology classified by category (refer to Category List of Geology)
16	Hydrogeology	Polygon	Prepared by JICA study team from hydrogeology map in 1967 by United Nations (1/200,000)	Boundary of hydrogeology classified by category (refer to Category List of Hydrogeology)
17	Lake	Polygon	ArcLeb	Boundary of Lake
18	Landuse1995	Polygon	ArcLeb	Boundary of land use in 1995 classified by category
19	LandUse2000	Polygon	Prepared by FAO in 2000	Boundary of land use in 2000 classified by category (refer to Category List of Land Use)
20	pointent250	Point	Prepared by JICA study team from Contours map	Point (x,y,z) on the contours at intervals of 250 meters
21	River	Line	ArcLeb	Centerline of river <category> Main Temporary

Map Data List

No.	Map (Layers/Name)	Type	Source	Description
22	SubBasin	Polygon	Prepared by JICA study team	Calculation unit area of SSM
23	WatershedArea	Polygon	Prepared by JICA study team based on information from topographic map (1:50,000) by the Direction of Affaires Geographic, Ministry of Defense	Boundary of watershed
24	Catchment	Polygon	Prepared by JICA study team	Boundary of catchment area of dam
25	Dam	Point	Prepared by JICA study team based on information from Ministry of Energy and Water	Position of existing and planning dam <category> 1: Dam 2: Hill lake
26	Road	Line	ArcLeb	Centerline of road <category> 1: Highway 2: Principal Road 3: Secondary Road 4: Other 5: Path
27	WasteWaterPlant	Point	Prepared by JICA study team from NERP yr 2/3 Feasibilities Studies and Environmental Assessment Reports - Water Supply Sector (Volumes of Central, North, South, Bekka), Howard Hamphry, 1995 and several water supply reports and maps in SIU-1, Ministry of Energy and Water	Position of existing and planning water treatment plant
28	WaterSourceTransmission	Line	Prepared by JICA study team from NERP yr 2/3 Feasibilities Studies and Environmental Assessment Reports - Water Supply Sector (Volumes for Central, North, South, Bekka), Howard Hamphry, 1995 and several water supply reports and maps in SIU-1, Ministry of Energy and Water	Line of water supply pipeline form sources to towns (not exact line)
29	WaterTreatmentPlant	Point	Prepared by JICA study team from paper map in 2000 by Ministry of Energy and Water	Position of existing and planning wastewater treatment plant

Map Data List

No.	Map (Layer) Name	Type	Source	Description
30	Climate	Polygon	Prepared by JICA study team from iso-hyetal map in 1971 by Meteorological Department, Ministry of Public Works and Transport	Boundary of climate zone <category> 1:North Lebanon 2:Central Lebanon 3:South Lebanon 4:North Mountain 5:Central Mountain 6:Inland Assi 7:Inland Litani 8:Inland Hansbani
31	Irrigation	Polygon	Prepared by JICA study team from Ministry of Energy and Water	Boundary of existing and planning irrigation
32	Hydro	Point	Prepared by JICA study team from Litani River Authority, Ministry of Energy and Water	Position of hydrological station
33	Meteoro	Point	Prepared by JICA study team from Meteorological Department, Ministry of Public Works and Transport	Position of meteorological station Station number < 1000: new station Station number >= 1000: old station
34	WQ_Groundwater	Point	Prepared by JICA study team from "Environmental Master Plan for Litani and Lake Qaraoun Catchment Area – Final Report", MVM consult AB, Sweden, May 31, 2000	Position of water quality survey site for groundwater
35	WQ_IndWasteWater	Point	Prepared by JICA study team from "Environmental Master Plan for Litani and Lake Qaraoun Catchment Area – Final Report", MVM consult AB, Sweden, May 31, 2000	Position of water quality survey site for industrial wastewater
36	WQ_Litani	Point	Prepared by JICA study team from "Environmental Master Plan for Litani and Lake Qaraoun Catchment Area – Final Report", MVM consult AB, Sweden, May 31, 2000	Position of water quality survey site in Litani river and Qaraoun
37	WQ_MuniWasteWater	Point	Prepared by JICA study team from "Environmental Master Plan for Litani and Lake Qaraoun Catchment Area – Final Report", MVM consult AB, Sweden, May 31, 2000	Position of water quality survey site for municipal wastewater
38	WQ_Qaraaoun	Point	Prepared by JICA study team from "Evaluation of Water Quality of the Qaraoun Reservoir Lebanon: Suitability for Multipurpose Usage", Journal of Environmental Monitoring and Assessment 2001	Position of water quality survey site in the Qaraoun
39	WQ_SeaWater	Point	Prepared by JICA study team from "Regional Environmental Assessment Report on the Coastal Zone of Lebanon", ECODIT-LAURIF, September, 1997	Position of water quality survey site for sea water
40	Spring	Point	Prepared by Ministry of Energy and Water	Position of spring

Map Data List

No.	Map (Layer) Name	Type	Description
41	Borehole	Point	Position of borehole
42	Well	Point	Position of well inventory survey
43	FS river	Point	Position of river of field survey
44	FS sea	Point	Position of seawater of field survey
45	FS spring	Point	Position of spring of field survey
46	GeoGrid250	Raster	Elevation raster data (cell size: 250 m)
47	TopographicMap (1-27)	Raster	Raster of topographic map
48	Satellite	Raster	Raster of satellite map

ArcLeb(prepared by Khatib & Alami): The 1: 100,000 series is drawn from the paper map series composed of six sheets prepared by the Direction of Affaires Geographic, Ministry of Defense. The overages contained are administrative boundaries (international, Mohafaza, Caza), roads, rivers, railroads, lakes, contours, and villages/towns (the last contains demographic data). The data covers the entire Lebanese territories.

Category List of Geology

GeoCode	Category	Category
10	Igneous Rocks	Basalts (Jurassic and Cretaceous)
11		Basalts (Miocene, Pliocene, and Quaternary)
12		Basaltic Lava-flows
13		Scoria
14		Cinders
20	Mesozoic	Green and Black Marls (Lias)
21		Black Dolomites and Ochre limestones (Bajocian)
22		Massive Limestones (Late Jurassic)
30		Sandstones (Aptian)
31		Alternation of Sandstones and Limestones (Aptian)
32		Alternation of Green Marls and Limestones (Albien)
33		Limestones (Cenomanian- Turonian)
34		Limestones and Limy Marls (Turonian)
35		Marls and White Marly Limestones (Senonian and Early Eocene)
40		White Marls and Semi-coral Limestones (Eocene- Oligocene)
50	Tertiary	Marly Conglomerates and Coral Limestones (Miocene)
51		Blue Clay, Sandy Marls and Limestones (Pliocene)
60		Marls and Lacustrine Marly Limestones (Miocene and Pliocene)
61		Conglomerates (Miocene and Pliocene)
70		Coastal Sandstone
71		Ancient Alluvium
72		Debris
73		Talus
74		Cultured Land
75		Coastal Sands
76	Quaternary	Present Alluvium
77		Red Soils
	Sedimentary Rocks	

Category List of Hydrogeology

GeoCode	Basic ground Water Layers	Lithology Facts	Age	Flow of Springs (l/sec)	Probable Momentary Flows (l/sec)	Transmitted (m ² /sec)	Extension of Outcrop (km)
10	Karstic Formations	Calcareous massifs and dolomitic calcareous including Marne Thickness: >1000 m	Jurassic, Bathonian, Portlandian	<100 100-1000 >1000	>100	$10 e^{-3} \leq T \leq 1$ the most often high	1290
11		Calcareous Thickness: 800 to 1000 m	Cretaceous, Cenomanian, Turonian	<100 100-1000 >1000	>100	$10 e^{-3} \leq T \leq 1$ the most often high	4290
12		Calcareous and Marne-calcareous with Flint beds Thickness: ~200 m	Cretaceous, Turonian	100-1000 >1000	>100	The most often high	100
13		Calcareous Subreefed Thickness: 100 to 800 m	Nummulitic Eocene	100-1000	<100	$10 e^{-4} \leq T \leq 10 e^{-2}$ Often high	317
14		Calcareous reefs Thickness: 200 to 250 m	Neocene Miocene	100-1000	<100	Often high	103
20	MeroKarstic Formations Extended layers	Calcareous, Marne Thickness: 100 to 300 m	Nummulitic Eocene	<100	<50	$10 e^{-4} \leq T \leq 10 e^{-2}$ Medioocre	536
30	Extended Layers	Big torrential Pudding stones - Marned Conglomerates Thickness: 500 to 600 m	Neocene Miocene and Pliocene	<100 or dispersed diffuse discharge	<30	$< 10^{-1}$ Medioocre or changing	746
31		Ancient Alluvium	Quaternary	Diffuse Discharge	<30	$10 e^{-4} \leq T \leq 10^{-3}$ Medioocre	68
32		Silt and "terra rossa" Thickness: 600 m	Quaternary	Diffuse Discharge	<10	Medioocre to weak very changing	830
40	Local or discontinued layers	Sandstones Thickness: 150 to 250 m	Cretaceous Sandstones	<10	<10	$10 e^{-5} \leq T \leq 10 e^{-6}$ Medioocre to weak	275
41	Local or discontinued layers	Unsticking slope and mudslide Thickness: variable	Quaternary	-	<10	Medioocre to weak	122
42		Red Grounds Thickness: variable	Quaternary	Diffuse Discharge	<10	Medioocre to weak	14

Category List of Hydrogeology

GeoCode	Underground Water Category	Lithology Faces	Age	Flow/ Springs (l/sec)	Probable Momentary Flows (l/sec)	Transmitted (m ² /sec)	Extension of Outcrop (km ²)
43		Littoral Sands Thickness: variable	Quaternary	Diffuse Discharge	<10	Mediocre to weak	12
44	Local or discontinued layers	Present alluvium Thickness: variable	Quaternary	Diffuse Discharge	<10	Mediocre to weak	7
45		Littoral Sandstones Thickness: variable	Quaternary	Diffuse Discharge	<10	Mediocre to weak	1
50		Alternance of clay-sandy territories, of calcareous and Marne, Thickness: 300 to 400 m	Cretaceous Aptian-Albian	<5	<5	Mediocre to weak	552
51		Marne and Marmo-Calcareous Thickness: 100 to 200 m	Cretaceous Senonian and Eocene basis	-	Very weak	Very weak	416
52		Marne Thickness: 50 m	Nummulitic Eocene	-			
53	Regions generally without layers or with very local layers	Marne Thickness: 50 m	Neocene Miocene- marine face	-	Very weak	Mediocre to weak	83
54		Marne and Marmo-Calcareous Thickness: ~900 m	Neocene continental face	-			
55		Clay, Sandy Marne and Calcareous Thickness: 250 to 400 m	Neocene Pliocene marine face	-	Very weak	Mediocre to weak	73
56		Basalt Thickness: variable	Cretaceous Miocene Pliocene Quaternary	-	Very weak	Very weak	365

Category List of Landuse			
Category	Category 2	Category 3	Category 4
100 Artificialized territories	110 Urbanized zone	111 Continuous urban tissue	111a Dense urban material
			111b Informal dense urban tissue
	112 Discontinuous urban tissue	112 Discontinuous urban tissue	112a Urban tissue- medium dense
			112b Informal medium dense urban tissue
			112c Urban tissue- little dense
			112d Informal little dense urban tissue
			112e Touristic complex
			112f Archeological site
	112g Equipment		
	120 Activity zone	121 Industrial or Commercial zone	121 Industrial or Commercial zone
			122 Port zone
			123 Airport
			124 Station
			131 Extraction of materials
132 Discharge			
133 Embankment in the sea			
134 Urban extension and/ or yard			
135 Vacant space			
141 Urban green space			
130 Artificialized zone (not built)	142 Big equipment for athletics or leisure	142 Big equipment for athletics or leisure	
		211 Cultivation of complete field in the big areas	
140 Artificial green zone	212 Cultivation of complete field in the small areas	211 Cultivation of complete field in the big areas	
		212 Cultivation of complete field in the small areas	
200 Agricultural territories	210 Intensive cultivation	231 Market gardening	112c Urban mitage on cultivation of complete field
			220 Orchard
			221 Olive trees
			222 Vineyard
			223 Fruitful trees (with nucleus or pips)
			223/211 Mixed (orchard & complete field)
			224 Citrus fruit
			225 Banana trees
			220
			230

Category List of Landuse

Category 1	Category 2	Category 3	Category 4	
200 Agricultural territories	230 Intensive cultivation	232 Under shelter	112c Urban mitage on intensive cultivation	
	230			
	240 Agricultural building			
300 Afforested areas	310 Dense forest	311 Dense conifer forest	311a Forest of « pinus, spp » dense 311b Forest of « cedar, spp » dense 311d Fir-free dense 311e Cupressus dense	
		312 Dense leafy forest	312a Forest of « Quercus spp » dense 312b Other type of dense leafy forests	
		313 Mixed dense forest		
	320 Sparse forest	321 Sparse conifer forest	112c Urban mitage on dense forest	112c Urban mitage on dense forest
			321a Forest of « pinus spp » sparse 321b Forest of « cedrus spp » sparse 321c Forest of « juniperus spp » sparse 321d Forest of « abies spp » sparse 321e Forest of « cupressus spp » sparse	321a Forest of « pinus spp » sparse 321b Forest of « cedrus spp » sparse 321c Forest of « juniperus spp » sparse 321d Forest of « abies spp » sparse 321e Forest of « cupressus spp » sparse
		322 Sparse leafy forest	322a Forest of « Quercus spp » sparse 322b Other type of sparse leafy forest	322a Forest of « Quercus spp » sparse 322b Other type of sparse leafy forest
			323 Mixed sparse forest	
	400 Areas of herbaceous vegetation	330 Shrubby zone	331 Shrub vegetation	112c Urban mitage on sparse forest
			332 Shrub vegetation (with scattered trees)	
		340 Burned or afforested zone		
410 Herbaceous vegetation- medium dense				
500 Marsh	420 Sparse herbaceous vegetation			
	510 Continental marsh			
	520 Salty marsh			
	610 Bare rock			
600 Non-productive areas	620 Bare ground			

Category 1		Category 2		Category 3		Category 4
600 Non-productive areas	630	Beach				
	640	Dunes of sands				
700 Surfaces at water	710	Aquatic continental areas	711	Man-made lake		
			712	Hilly lake		
	720	Maritime aquatic areas	721	Sea		
			722	Port basin		
800 Road network	810	Highway				
	820	Other type of roads				

Attribute Data List

No	Map Name	No	Field Name	Type	Width	Unit	Description
1	Border	1	Area	Double	19	m ²	Generated by the system, it is the area of a polygon feature
		2	Perimeter	Double	19	m	Generated by the system, it is the perimeter of a polygon feature
		3	Name	String	10	-	Country name
		4	SYMBOL	Integer	10	-	Key ID
2	Caza	1	Area	Double	19	m ²	Generated by the system, it is the area of a polygon feature
		2	Perimeter	Double	19	m	Generated by the system, it is the perimeter of a polygon feature
		3	Code	Integer	5	-	Code number of Caza
		4	MohafazaCD	Integer	1	-	Code number of Mohafaza
		5	Name	String	30	-	Caza name
3	Mohafaza	1	Area	Double	19	m ²	Generated by the system, it is the area of a polygon feature
		2	Perimeter	Double	19	m	Generated by the system, it is the perimeter of a polygon feature
		3	Name	String	20	-	Mohafaza name
		4	Code	Integer	4	-	Code number of Mohafaza
4	NewWaterAuthority	1	Area	Double	19	m ²	Generated by the system, it is the area of a polygon feature
		2	Perimeter	Double	19	m	Generated by the system, it is the perimeter of a polygon feature
		3	WA_No	Integer	4	-	Code number of new water authority
		4	Name	String	20	-	New water authority name
5	Town	1	TownName	String	30	-	Town or village name
		2	KEY_ID	Integer	10	-	Unique number in town or village
		3	MohaName	String	50	-	Mohafaza name
		4	KadaaName	String	50	-	Caza name
		5	CadastName	String	50	-	Cadastral name
		6	MohafazaCD	Integer	1	-	Code number of mohafaza
		7	KadaaCD	Integer	2	-	Code number of caza
		8	CadastCD	Integer	5	-	Code number of cadastral
		9	Category	Integer	4	-	Category code number 1-Capital of Mohafaza 2-Capital of Caza
6	WaterAuthority	1	WA_No	Integer	4	-	Code number of water authority
		2	Name	String	30	-	Water authority name
		3	Area	Double	19	m ²	Generated by the system, it is the area of a polygon feature
7	WaterSupplyZoning	1	Area	Double	19	m ²	Generated by the system, it is the area of a polygon feature
		2	SystemNo	String	5	-	Code number of water supply system
		3	WA_Name	String	20	-	Water authority name

Attribute Data List

No.	Map Name	No.	Field Name	Type	Width	Height	Description
7	WaterSupplyZoning	4	Sys Name	String	30	-	Water supply system name
		5	Com Name	String	20	-	Water committee name
		6	Com No	String	3	-	Code number of water committee
		1	MapNo	Integer	4	-	Code number of topographic map
		2	MapName	String	20	-	Topographic map name
		1	Area	Double	19	m ²	Generated by the system, it is the area of a polygon feature
9	DemandArea	2	Perimeter	Double	19	m	Generated by the system, it is the perimeter of a polygon feature
		3	MohafName	String	50	-	Mohafaza name
		4	MohafazaCD	Integer	1	-	Code number of Mohafaza
		5	Name	String	30	-	Demand area name
10	SupplyArea	6	AreaNo	Integer	4	-	Code number of demand area
		1	AreaNo	Integer	4	-	Code number of demand area
		2	Name	String	30	-	Supply area name
		3	Area	Double	19	m ²	Generated by the system, it is the area of a polygon feature
		4	SubNo	Integer	4	-	Sub number of supply area
		5	Category	Integer	4	-	Category code number 1: Domestic river 2: International river
11	Barycenter	6	AID	Integer	4	-	Number of watershed
		1	X	Double	19	-	X coordinate value
		2	Y	Double	19	-	Y coordinate value
		3	AreaNo	Integer	4	-	Code number of demand area
12	Base	4	Code	String	5	-	Code of sub basin
		-	-	-	-	-	-
13	Contours	1	Elevation	Integer	9	m	Elevation
		1	Length	Double	19	m	Length of fault
14	Fault	2	Name	String	20	-	Fault name
		1	GeoCode	Integer	4	-	Code number of geology
15	Geology	2	Area	Double	19	m ²	Generated by the system, it is the area of a polygon feature
		3	GeoName	Double	19	m ²	Geology name
		1	GeoCode	Integer	4	-	Code number of hydrogeology
16	Hydrogeology	2	Area	Double	19	m ²	Generated by the system, it is the area of a polygon feature
		1	Area	Double	19	m ²	Generated by the system, it is the area of a polygon feature
17	Lake	1	Area	Double	19	m ²	Generated by the system, it is the area of a polygon feature
		2	Perimeter	Double	19	m	Generated by the system, it is the perimeter of a polygon feature

Attribute Data List

No.	Map Name	No.	Field Name	Type	Width	Unit	Description
17	Lake	3	Name	String	20	-	Lake name
18	Landuse1995	1	Area	Double	19	m ²	Generated by the system; it is the area of a polygon feature
		2	Perimeter	Double	19	m	Generated by the system; it is the perimeter of a polygon feature
		3	VEG_CODE	String	10	-	Code of land use
		4	DESCRIPTIO	String	200	-	Description of land use
		5	Major Code	Integer	4	-	Major code number of land use
19	LandUse2000	1	Area	Double	19	m ²	Generated by the system; it is the area of a polygon feature
		2	Perimeter	Double	19	m	Generated by the system; it is the perimeter of a polygon feature
		3	Code	String	16	-	Code of land use
		4	CODE1	Integer	4	-	Major code number of land use
		5	CODE2	Integer	4	-	Middle code number of land use
		6	CODE3	Integer	4	-	Minor code number of land use
20	pointent250	1	Elevation	Integer	9	m	Elevation
21	River	1	LENGTH	Double	19	m	Generated by the system; it is the perimeter of a polygon feature
		2	CATEGORY	String	10	-	Category code Main: main river Temporary: temporary river
22	SubBasin	3	NAME	String	25	-	River name
		1	AreaNo	Integer	4	-	Code number of sub-basin
		2	Name	String	30	-	Sub-basin name
		3	Area	Double	19	m ²	Generated by the system; it is the area of a polygon feature
		4	Code	String	5	-	Code of sub-basin
23	WatershedArea	1	AreaNo	Integer	4	-	Code number of watershed
		2	Name	String	30	-	Watershed name
		3	Area	Double	19	m ²	Generated by the system; it is the area of a polygon feature
		4	SubNo	Integer	4	-	Sub number of watershed
		5	Category	Integer	4	-	Category code number 1: Domestic river 2: International river
24	Cathment	6	AID	Integer	4	-	Number of watershed
		1	DamNo	Integer	4	-	Code number of dam
		2	Area	Double	19	m ²	Generated by the system; it is the area of a polygon feature
25	Dam	1	DamNo	Integer	9	-	Code number of dam

Attribute Data List

No.	Map Name	No.	Field Name	Type	Width	Unit	Description
25	Dam	2	Category	Integer	4	-	Code number of dam type 1: dam 2: hill lake
		3	MOHAFAZA	String	16	-	Mohafazaname
		4	NAME	String	50	-	Dam name
		5	DOMESTIC	String	56	-	Dam purpose
		6	IRRIGATION	String	50	-	Dam purpose
		7	INDUSTRY	String	50	-	Dam purpose
		8	HYDROPOWE R	String	50	-	Dam purpose
		9	TOURISM	String	50	-	Dam purpose
		10	FLOOD	String	50	-	Dam purpose
		11	WORKDONE	String	20	-	Work Done
		12	PRESENTPHA	String	64	-	Present phase
		13	STCAPACITY	Integer	19	million m ³	Storage capacity
		14	ACTSTORAGE	String	20	million m ³	Active storage
		15	TYPE	String	20	-	Dam type
		16	MAXHEIGHT	String	20	m	Max. Height
		17	CRESTLEN	String	20	m	Crest length
		18	CRESTLEL	String	20	m	Crest elevation
		19	HWL	String	20	m	High water level
		20	Horizon	Integer	4	-	Starting year
		26	Road	1	LENGTH	Double	19
2	TYPE			Integer	1	-	Code number of road type
3	CATEGORY			String	15	-	Category of road type
27	WastewaterPlant	1	Code	Integer	4	-	Code number of wastewater treatment plant
		2	CAZA	String	9	-	Caaza name
		3	REGION	String	19	-	Region name
		4	INHABITANT	Integer	16	-	Inhabitant
		5	CAPACITY	Integer	10	m ³ /day	Capacity
		6	HORIZON	Integer	9	-	Start year
		7	LEVEL	String	14	-	Level of considered treatment

Attribute Data List

No.	Map Name	No.	Field Name	Type	Width	Unit	Description		
27	WastewaterPlant	8	OFFICE	String	12	-	Study office name		
		9	STUDYLEVEL	String	14	-	Study level		
		10	COST1	Integer	13	US\$	Treatment cost		
		11	COST2	Integer	12	US\$	Territory cost		
		12	TOTALCOST	Integer	15	US\$	Total cost		
		13	STUDYWORK	String	12	-	Master study work		
		14	FINANCING	String	13	-	Financing		
		15	ReuseRate	Single	13	-	Reuse rate		
		28	WaterSourceTransmission	1	LENGTH	Double	19	m	Generated by the system; it is the perimeter of a polygon feature
				1	Region	String	20	-	Region name
		29	WaterTreatmentPlant	2	Water_Auth	String	20	-	Water authority name
				3	Plant	String	50	-	Plant name
				4	Capacity	Integer	9	-	Capacity
				5	Tr process	String	100	-	
				6	Wat source	String	50	-	Source name
1	AREA			Double	19	m ²	Generated by the system; it is the area of a polygon feature		
30	Climate	2	AreaNo	Integer	4	-	Code number of climate zone		
		3	Name	String	30	-	Climate zone name		
		1	AreaNo	Integer	4	-	Code number of irrigation area		
31	Irrigation	2	sYear	Integer	4	-	Start year		
		3	Area	Double	19	m ²	Generated by the system; it is the area of a polygon feature		
		4	Climate	Integer	4	-	Climate zone code number		
		5	Name	String	50	-	Name		
		6	AreaHa	Double	19	ha	Irrigation area		
		1	STATIONNO	Integer	11	-	Code number of station		
32	Hydro	2	RIVER	String	19	-	River name		
		3	NAME	String	22	-	Station name		
		4	AREA	Single	14	km ²	Area of watershed		
		5	ELEVATION	Single	16	m	Elevation		
		6	LAT DEG	Integer	9	degree	Latitude (degree)		
		7	LAT MIN	Integer	9	minute	Latitude (minute)		
		8	LAT SEC	Integer	9	second	Latitude (second)		
		9	LON DEG	Integer	9	degree	Longitude (degree)		
		10	LON_MIN	Integer	9	minute	Longitude (minute)		

Attribute Data List

No.	Map Name	Ms	Field Name	Type	Width	Unit	Description
32	Hydro	11	LON_SEC	Integer	9	second	Longitude (second)
		12	Watershed	String	-	-	Watershed name
33	Metecoro	1	STATIONNO	Integer	16	-	Code number of station
		2	Name	String	26	-	Station name
		3	Year	Integer	9	-	Start year of observation
		4	Mon	Integer	9	-	Start month of observation
		5	Day	Integer	9	-	Start day of observation
		6	LAT_DEG	Integer	9	degrec	Latitude (degree)
		7	LAT_MIN	Integer	9	minute	Latitude (minute)
		8	LAT_SEC	Integer	9	second	Latitude (second)
		9	LON_DEG	Integer	9	degrec	Longitude (degree)
		10	LON_MIN	Integer	9	minute	Longitude (minute)
11	LON_SEC	Integer	9	second	Longitude (second)		
12	ELEVATION	Single	16	m	m	Elevation	
34	WQ_Groundwater	1	X	Integer	9	m	X coordinate value
		2	Y	Integer	9	m	Y coordinate value
		3	LOCATION	String	14	-	Name of location
		4	COMMENTS	String	14	-	Comments
		5	DATE	Date	8	-	Observational date
		6	NO	Integer	7	-	Code number
		7	TOTAL_COLI	Integer	13	colonics/ 100ml	Total coliforms
		8	E_COLI	Integer	10	colonics/ 100ml	Fecal Coliforms
		9	SULFATES	Integer	11	mg/l	Sulfates
		10	CHLORIDES	Integer	11	mg/l	Chlorides
		11	CONDUCTIVI	Integer	13	uS/cm	Conductivity
		12	ALKALINITY	Integer	13	mg/l	Alkalinity
		13	PH	Integer	6	-	pH
		14	TOTAL_HARD	Integer	13	mg/l	Total hardness
		15	TURBIDITY	Integer	12	NTU	Turbidity
		16	NITRATES	Integer	11	mg/l	Nitrates
		17	AMMONIA	Integer	11	mg/l	Ammonia
		18	AL	Integer	5	µg/l ppb	Al

Attribute Data List

No.	Map Name	No.	Field Name	Type	Width	Unit	Description	
34	WQ_Groundwater	19	CR	Integer	5	µg/l ppb	Cr	
		20	MN	Integer	5	µg/l ppb	Mn	
		21	FE	Integer	5	µg/l ppb	Fe	
		22	NI	Integer	5	µg/l ppb	Ni	
		23	CU	Integer	5	µg/l ppb	Cu	
		24	ZN	Integer	5	µg/l ppb	Zn	
		25	AS	Integer	5	µg/l ppb	As	
		26	CD	Integer	5	µg/l ppb	Cd	
		27	PB	Integer	5	µg/l ppb	Pb	
		28	HG	Integer	5	µg/l ppb	Hg	
		29	COD	Integer	5	mg/l	COD	
		30	TOC	Integer	5	mg/l	TOC	
		31	DO1	Integer	5	mg/l	DO1	
		32	DO5	Integer	5	mg/l	DO5	
		1	X	Integer	9	m		X coordinate value
		2	Y	Integer	9	m		Y coordinate value
		3	LOCATION	String	14	-		Name of location
4	INDUSTRY	String	14	-		Name of industry		
5	COMMENTS	String	53	-		Comments		
6	DATE	Date	8	-		Observational date		
7	NO	Integer	11	-		Code number		
8	FLOW	Single	12	m ³ /h		Flow		
9	CHLORIDES	Single	11	mg/l		Chlorine		
10	ORTHO-PHOS	Single	13	mg/l		Ortho-phosphates		
11	AMMONIA	Single	12	mg/l		Ammonia		
12	SULFATES	Single	11	mg/l		Sulfates		
13	CONDUCTIVI	Single	11	uS/cm		Conductivity		
14	PH	Single	12	-		pH		
15	AL	Single	11	µg/l		Al		
16	CR	Single	11	µg/l		Cr		
17	MN	Single	11	µg/l		Mn		
18	FE	Single	11	µg/l		Fe		
19	NI	Single	11	µg/l		Ni		
20	CU	Single	11	µg/l		Cu		
35	WQ_IndWasteWater							

No.	Map Name	Attribute Data List				Description			
		No.	Field Name	Type	Width		Unit		
35	WQ_IndWasteWater	21	ZN	Single	11	µg/l	Zn		
		22	AS	Single	11	µg/l	As		
		23	CD	Single	11	µg/l	Cd		
		24	PB	Single	11	µg/l	Pb		
		25	HG	Single	11	µg/l	Hg		
		26	COD	Single	11	mg/l	COD		
		27	TOC	Single	11	mg/l	TOC		
		28	DO1	Single	11	mg/l	DO1		
		29	DO5	Single	11	mg/l	DO5		
		30	N_TOT	Single	11	mg/l	Total nitrates		
		31	NITRATES	Single	11	mg/l	Nitrates b		
		32	NITRITES	Single	11	mg/l	Nitrates		
		33	SS	Single	11	mg/l	SS		
		34	CA	Single	11	mg/l	Ca		
		35	K	Single	11	mg/l	K		
		36	SI	Single	11	mg/l	Si		
		37	CO	Single	11	mg/l	Co		
		38	LI	Single	11	mg/l	Li		
		39	MG	Single	11	mg/l	Mg		
		40	MO	Single	11	mg/l	Mo		
		41	NA	Single	11	mg/l	Na		
		42	SR	Single	11	mg/l	Sr		
		43	S	Single	11	mg/l	S		
		44	V	Single	11	mg/l	V		
		45	BOD7	Single	11	mg/l	BOD7		
		46	B	Single	11	mg/l	B		
		47	ALKALINITY	Single	11	mg/l	Alkalinity		
		48	TEMPC	Single	11	degree	Temperature		
		36	WQ_Litani	1	X	Integer	9	m	X coordinate value
				2	Y	Integer	9	m	Y coordinate value
				3	SAMPLE_ID	String	14	-	Code number
				4	DATE	Date	8	-	Observational date
				5	LOCATION	String	20	-	Name of location
				6	COMMENTS	String	50	-	Comments

Attribute Data List

No	Map Name	No	Field Name	Type	Unit	Description
36	WQ_Litani	7	TOTAL_COLI	Single	colonies/ 100ml	Total coliforms
		8	E_COLI	Single	colonies/ 100ml	Fecal coliforms
		9	SULFATES	Single	mg/l	Sulfates
		10	CHLORIDES	Single	mg/l	Chlorides
		11	CONDUCTIVI	Single	uS/cm	Conductivity
		12	ALKALINITY	Single	mg/l	Alkalinity
		13	PH	Single	-	pH
		14	ORTHO PHOS	Single	mg/l	Ortho-phosphates
		15	SS	Single	mg/l	SS
		16	AL	Single	ug/l ppb	Al
		17	CR	Single	ug/l ppb	Cr
		18	MN	Single	ug/l ppb	Mn
		19	FE	Single	ug/l ppb	Fe
		20	NI	Single	ug/l ppb	Ni
		21	CU	Single	ug/l ppb	Cu
		22	ZN	Single	ug/l ppb	Zn
		23	AS	Single	ug/l ppb	As
		24	CD	Single	ug/l ppb	Cd
		25	PB	Single	ug/l ppb	Pb
		26	HG	Single	ug/l ppb	Hg
		27	COD	Single	mg/l	COD
		28	TOC	Single	mg/l	TOC
		29	DO1	Single	mg/l	DO1
		30	DO5	Single	mg/l	DO5
		31	BOD5	Single	mg/l	BOD5
		32	Temp	Single	degree	Temperature
		33	N tot	Single	mg/l	Total Nitrates
		34	Nitrates	Single	mg/l	Nitrates b
		35	Nitrites	Single	mg/l	Nitrites
		36	Ammonia	Single	mg/l	Ammonia
		37	Ca	Single	mg/l	Ca
		38	K	Single	mg/l	K

Attribute Data List

No.	Map Name	No.	Field Name	Type	Width	Unit	Description
36	WQ_Litani	39	Si	Single	11	mg/l	Si
		40	Co	Single	11	mg/l	Co
		41	Li	Single	11	mg/l	Li
		42	Mg	Single	11	mg/l	Mg
		43	Mo	Single	11	mg/l	Mo
		44	Na	Single	11	mg/l	Na
		45	Sr	Single	11	mg/l	Sr
		46	S	Single	11	mg/l	S
		47	V	Single	11	mg/l	V
		48	Ag	Single	11	mg/l	Ag
		49	Sn	Single	11	mg/l	Sn
		50	BOD7	Single	11	mg/l	BOD7
		51	B	Single	11	mg/l	B
		52	Turbidity	Single	11	-	Turbidity
		53	Colour	Single	11	mgPt/l	Colour
54	DOC	Single	11	mg/l	DOC		
55	T E alifat	Single	11	mg/l	Total extractable alifate hydrocarbons		
56	Non_alifat	Single	11	mg/l	Nonpolar alifate hydrocarbons		
57	T extracta	Single	11	mg/l	Total extractable hydrocarbons		
37	WQ_MuniWasteWater	1	X	Integer	9	m	X coordinate value
		2	Y	Integer	9	m	Y coordinate value
		3	LOCATION	String	26	-	Name of location
		4	LOCATION 1	String	51	-	Detailed location name
		5	DATE	Date	8	-	Observational date
		6	NO	Integer	12	-	Code number
		7	CHLORIDES	Single	11	mg/l	Chlorides
		8	ORTHO PHOS	Single	11	mg/l	Ortho-phosphates
		9	AMMONIA	Single	11	mg/l	Ammonia
		10	SULPHATES	Single	11	mg/l	Sulfates
		11	CONDUCTIVI	Single	11	uS/cm	Conductivity
		12	PH	Single	11	-	pH
		13	AL	Single	11	µg/l ppb	Al
		14	COD	Single	11	mg/l	COD
		15	TOC	Single	11	mg/l	TOC

Attribute Data List

No.	Map Name	No.	Field Name	Type	Width	Unit	Description
37	WQ_MumWasteWater	16	DO1	Single	11	mg/l	DO1
		17	DO5	Single	11	mg/l	DO5
		18	BOD	Single	11	mg/l	BOD
		19	PTOT	Single	11	mg/l	Total PTOT
		20	Cr	Single	11	µg/l ppb	Cr
		21	Mn	Single	11	µg/l ppb	Mn
		22	Fe	Single	11	µg/l ppb	Fe
		23	Ni	Single	11	µg/l ppb	Ni
		24	Cu	Single	11	µg/l ppb	Cu
		25	Zn	Single	11	µg/l ppb	Zn
		26	As	Single	11	µg/l ppb	As
		27	Cd	Single	11	µg/l ppb	Cd
		28	Pb	Single	11	µg/l ppb	Pb
		29	Hg	Single	11	µg/l ppb	Hg
		30	N_TOT	Single	11	mg/l	Total nitrates
		31	Ca	Single	11	mg/l	Ca
		32	K	Single	11	mg/l	K
		33	Si	Single	11	mg/l	Si
		34	Co	Single	11	mg/l	Co
		35	Li	Single	11	mg/l	Li
		36	Mg	Single	11	mg/l	Mg
		37	Mo	Single	11	mg/l	Mo
		38	Na	Single	11	mg/l	Na
		39	Sr	Single	11	mg/l	Sr
40	S	Single	11	mg/l	S		
41	V	Single	11	mg/l	V		
42	Ag	Single	11	mg/l	Ag		
43	Sn	Single	11	mg/l	Sn		
44	BOD7	Single	11	mg/l	BOD7		
38	WQ_Qaraoun	1	ObsNo	Integer	4	-	Code number
		2	Year	Integer	4	-	Observational year
		3	Temp	Single	11	degree	Temperature
		4	pH	Single	11	-	pH
		5	Cond	Single	11	mg/l	Cond

Attribute Data List		No	Map Name	No	Field Name	Type	Width	Unit	Description	
38	WQ_Qaraaoun	6	TDS	11	mg/l	TDS				
		7	HCO3	11	mg/l	HCO ₃				
		8	Cl	11	mg/l	Cl				
		9	PO4	11	mg/l	PO ₄				
		10	SO4	11	mg/l	SO ₄				
		11	NO3	11	mg/l	NO ₃				
		12	NO2	11	mg/l	NO ₂				
		13	NH3	11	mg/l	NH ₃				
		14	DO	11	mg/l	DO				
		15	BOD	11	mg/l	BOD				
		16	Ca	11	mg/l	Ca				
		17	Mg	11	mg/l	Mg				
		18	Na	11	mg/l	Na				
		19	Al	11	mg/l	Al				
		20	Fe	11	mg/l	Fe				
		21	Zn	11	mg/l	Zn				
		22	Cr	11	mg/l	Cr				
		23	Cu	11	mg/l	Cu				
		24	As	11	mg/l	As				
		1	Station	4	-	-	Station number			
		2	Name	4	-	-	Station name			
		3	Year	4	-	-	Observational year			
		4	FC50	4	FC/100m	1	Fecal coliforms			
		5	FC90	4	FC/100m	1	Fecal coliforms			
40	Springs	1	SID	4	-	ID number				
		2	CODE	4	-	Code number of spring				
		3	MAPREF	20	-	Name of reference map				
		4	MAPNAME	20	-	Map name				
		5	MOHAF	20	-	Mohafaza name				
		6	CAZA	20	-	Caaza name				
		7	REGION	20	-	Region name				
		8	NAME	20	-	Spring name				

Attribute Data List

No.	Map Name	No	Field Name	Type	Width	Unit	Description
40	Springs	9	DIVCODE	String	1	-	Category code S: spring A: ain
		10	X	Single	19	-	X coordinate value
		11	Y	Single	19	-	Y coordinate value
		12	Z	Single	19	-	Z coordinate value
		1	ID	Integer	4	-	ID number
		1	CODE	String	9	-	Code
		2	X	Single	19	degree	X coordinate value
		3	Y	Single	19	degree	Y coordinate value
		4	EL	Single	19	m	Elevation of mouth
		5	OWNER	String	38	-	Owner or manager of wells
		6	Irrigation	String	9	-	Intended purpose (irrigation)
		7	Domestic	String	9	-	Intended purpose (domestic)
		8	Year	Integer	9	-	Year of construction
		9	Depth	Single	9	m	Depth of drilling
		10	Structure	String	15	-	Structure
		11	OWL	Single	4	m	Original water level
		12	SWL	Single	4	m	Static water level
		13	DWL	Single	4	m	Dynamic water level
14	Type	String	19	-	Pump type		
15	Capacity	String	24	-	Pump capacity		
16	Power	String	20	-	Source of power		
17	Daily	Single	15	m ³	Average pumping rates (daily)		
18	Monthly	Single	15	m ³	Average pumping rates (monthly)		
43	FS_river	1	CODE	Integer	4	-	Code number
		2	NAME	String	20	-	River name
		3	X	Single	19	degree	Decimal degree system
		4	Y	Single	19	degree	Decimal degree system
		5	Z	Single	19	m	Elevation
44	FS_sca	1	CODE	Integer	4	-	Code number
		2	NAME	String	20	-	Town name
		3	X	Single	19	degree	Decimal degree system
		4	Y	Single	19	degree	Decimal degree system

Attribute Data List

No.	Map Name	Nb.	Field Name	Type	Width	Unit	Description
44	FS_sea	5	Z	Single	19	m	Elevation
45	FS_spring	1	CODE	Integer	4	-	Code number
		2	NAME	String	20	-	Spring name
		3	VILLAGE	String	20	-	Village name
		4	X	Single	19	degree	Decimal degree system
		5	Y	Single	19	degree	Decimal degree system
		6	Z	Single	19	m	Elevation

Appendix 2

Definition of DBM Database