WATER REFORM
long term technical assistance

EU-AFD TECHNICAL ASSISTANCE PROGRAMME TO SUPPORT REFORMS IN THE WATER AND WASTEWATER SECTORS IN LEBANON

Funded by the European Union

AFD AGENCE FRANÇAISE DE DÉVELOPPEMENT
Implemented by AFD

BWE

PRELIMINARY ASSESSMENT OF THE GIS SYSTEM

September 2022

Hydroconseil L'ingénierie au service du développement

HYDROPHIL VA

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LIST OF ACRONYMS

AFD	Agence Française de Développement
BMLWE	Beirut and Mount Lebanon Water Establishment
BoQ	Bill of Quantities
BWE	Beqaa Water Establishment
CDR	Council for Development and Reconstruction
DMA	District Metering Area
EU	European Union
EUD	European Union Delegation
GIS	Geographic Information System
GPS	Geographic Positioning System
HR	Human Resources
KE	Key Expert
LRA	Litani River Authority
LTTA	Long Term Technical Assistance
MoEW	Ministry of Energy and Water
NLWE	North Lebanon Water Establishment
NRW	Non-Revenue Water
NWSS	National Water Sector Strategy
SLWE	South Lebanon Water Establishment
TA	Technical Assistance
TL	Team Leader
ToR	Terms of Reference
WE	Water Establishments
WMP	Water Master Plan
WSMP	Water Supply Master Plan
WTP	Water Treatment Plant

1 INTRODUCTION

1.1 General

Within the framework of the "Technical Assistance Program to support Reforms in the Water and Wastewater sectors in Lebanon", funded by the European Union and implemented by AFD, it is foreseen to "*Strengthen regional Planning Tools*".

By *Planning Tools*, it is meant those tools presently available to the WEs, which are :

- The Master Plans,
- The GIS system,
- The SCADA system
- The ERP system,

The present report covers GIS systems. It is a preliminary assessment of the status of the GIS system presently in use at BWE, as part of a set of four reports covering the general assessment for the GIS systems in use in all four WEs.

At the water sector level, the end purpose of these preliminary assessments is to propose (and eventually have implemented) a unified GIS systems for all the WEs, to their satisfaction. This would allow providing the MoEW with a single tracking tool and a single set of KPIs to monitor the WEs' performance.

At the WE level, this report is a starting point for the WEs to update their current implementation of GIS technology. This includes the assessment and review of the existing GIS in order to set up a system compliant with international standards and serve its purposes. Appropriate GIS systems enable the WEs to identify their assets, manage their infrastructure and systems, plan short and medium-term interventions, and set long-term strategies.

1.2 Scope of this assessment

The scope of this activity is to:

- Assess and review the current situation regarding GIS in terms of IT infrastructure, tools, database and allocated human resources; then highlight gaps and propose relevant upgrades for a better management and planning of capital investments.
- Ultimately, and if deemed necessary following this preliminary assessment, prepare ToR to assign a GIS consultant to support the WEs in updating / upgrading their GIS database as may be required.

To carry out this activity the LTTA team shall:

- Identify in each WE the available GIS IT infrastructures such as servers, workstations, GIS tool, licenses, and highlight gaps and needs if any.

- Assess the current situation in each WE regarding the GIS Data base's structure and architecture, the available data, the type of data (physical, operational, etc.), compliance, cleanness, completeness, accuracy, historical and geographical coverage, Verify the compliance of the GIS data to be used in hydraulic modeling and investment planning, and identify gaps and upgrades to build a relevant GIS database.
- Verify the integration of the GIS with other systems in use such as ERP, Water Quality management system, O&M CMMS system, SCADA, etc.
- List and evaluate the Human resources assigned (or should be assigned) to GIS activities, their education level, experience and acquired skills, trainings and certificates, and identify the needs for additional staff and /or additional training.

2 GENERAL ASSESSMENT PRINCIPLES

2.1 GIS use objectives

The GIS system is a data base for storage and diagnosis in the first stage, and a tool for management and planning of water systems in the second stage. Those GIS specificities all gathered into one system, will form a decision support system for daily tasks, future planning and help establish Strategic Scenarios for new short and long term investments at WE's.

GIS will consequently represent a Management Information System which can be best described as a system to store and deliver reliable data, in an efficient manner to the required planning processes. Ultimately, GIS will be a tool at the WE for a smoothly functioning work flow process that integrates information for water demand forecasting, engineering, client management, operations support, and maintaining systems assets inventory.

In Fact, the main objectives of the GIS system are the following:

- Act as storage pool for digital spatial data;
- Provide a storage pool to gather all relevant data related to water systems.
- Provide an easy access to spatial data and as built drawings;
- Be used as an analytical planning tool;
- Produce cartographic maps;
- Perform simple spatial analysis, spatial modelling and simulations;
- A step to standardize the data;
- Aid in conducting statistical analysis to forecast future outcomes ;
- Generate options and alternatives for investment planning;
- Ultimately, act as management and planning tool for short term work plans and long term strategies.

2.2 Mthodology

The assessment shall follow the steps below ::

- Identify in each WE the available GIS IT infrastructures as server, workstations, GIS tool, licenses, and highlight gaps and needs if any.
- Assess the current situation in each WE regarding the GIS Data base structure and architecture, layers organisation, the available data, the type of data (physical, operational, etc.), cleanness, completeness, accuracy, historical and geographical coverage, and identify gaps and upgrades to build a relevant GIS database.

- Verify the integration of the GIS with other systems in use as ERP, Water Quality management system, O&M system, SCADA, etc.
- List and evaluate the Human resources assigned to GIS activities (permanent staff, on demand, etc.), their education level, experience and acquired skills, trainings and certificates, and identify the needs for additional staff.

2.3 GIS Assessment basis

The GIS system is assessed according to 3 main pillars:

- IT infrastructures (Hardware and software)
- GIS data base
- Staff and human resources

2.3.1 GIS IT system

Server equipment, GIS Licensing, configuration of GIS software and servers for the four WEs will serve as the basis for forming the GIS units for the WEs. A summary of available hardware, software's, licences and the specifications of the server for the Four water establishments will be presented as provided by the WEs.

2.3.2 GIS data base

Detailed understanding of water systems (assets, management, operation and maintenance procedures) and analysis of existing tools and data is essential to designing a suitable and user-oriented GIS. This task was conducted by the LTTA expert, through the following:

- Interviews with each WE to identify objectives and information gaps;
- Understand the GIS database basis approach (Asset valuation, storage pool and archiving, management, planning)
- Analyse the architecture and structure of data base (layers, by projects, not defined, etc.)
- Check the geometric conformity of data and network topology
- Check the compliance of attributes labelling, units, data entry, definition of attributes, completeness of attributes, missing of some attributes, etc.
- Understand the procedure of Data base update (SOP, Manual, guideline)
- Verify the integration with other systems (ERP, SCADA, Hydraulic software)
- Analyse the existing data in each WE database in terms of layers, type of data (graphical either vector or raster, alphanumeric data, metadata, etc.), nature of data

(Physical, operational, calculated, measured, coverage, completeness, accuracy, span, etc.)

- Identify the availability of satellite images, Topographic maps, contours lines, Digital Elevation Model (DEM), Roads, Land use, soil map etc.
- Check the availability of cadastral data, housing units' footprints, etc.

2.3.3 Staff and Human resources

The assessment of the GIS staff consisted to list the GIS staff assigned to GIS activities (permanent staff, on demand, etc.), their acquired skills and education background, and identify the needs for additional staff.

2.4 GIS System design approach

To establish a data model suitable to real needs and organize the data collection consequently, particular attention shall be given to:

- Understanding of the need for the GIS system (what is it intended for? Storage? Diagnosis? Analysis? Asset Valuation? Planning? etc.?),
- Deduce requirements in terms of accuracy, coverage, completeness, compliance, data collection procedures, data integration, topology and geometry, etc.
- Accurate understanding of the "Asset Water Management" concept

3 BWE GIS ASSET AND INFRASTRUCTURES

In the following, we present a summary on assets and infrastructures as they were collected from the BWE. Enclosed are the extracted data pertaining to layers from the GIS database

3.1 Description of mapped and GIS assets

The GIS data base and layers cover wells, springs, reservoirs, and the main distribution networks. Reliability suffers due to many fields not being completed. BWE GIS data highly relies the asset valuation done by Libanconsult under a GIZ program, and included and updated in BWE 2015 Master Plan drafted by KREDO under USAID LWWSS program. The labelling of assets often indicates whether the data was provided to BWE by the Master Plan or other sources.

Table 3.1-1 Summary of GIS assets.

Region	Springs	Wells	Reservoirs
Baalbeck	23	108	103
North Bekaa	11	42	45
South Bekaa	18	97	125
Zahle	8	44	45
Grand Total	60	291	318

Many of the wells have been indicated as not being operated by BWE. However, the number is uncertain due to 80 wells not being tagged for operating entity.

Table 3.1-2 Summary of GIS wells by status.

Operated by	Wells
(Blank)	80
BWE	62
Municipality	92
Other	56
Private	1
Grand Total	291

Moreover, free text notes indicate that 37 wells are not in use. However, the remaining wells were not confirmed to be in use. Comparing ownership and operation shows a mixture and many unknowns.

Table 3.1-3 GIS well ownership vs. operations.

	well operated by					
Well owned by	BWE	Municipality	Other	Private	(blank)	Grand Total
BWE	60	64	45		2	171
Municipality	2	26	11	1		40
(blank)		2			78	80
Grand Total	62	92	56	1	80	291

The length of pipe networks that was provided from the GIS export showed that in one file the segments were flagged as being digitised during or in relation the USAID Master Plan of 2015. The total length of pipe does not reach more than half of the estimated 3000 km as mentioned in the 2016 annual report understandably as the master plan was not concerned with the details of local tertiary networks.

Table 3.1-4 GIS transmission line status by length.

Status	Qty (m)
assessment	765718
Existing	506395
Under Constraction	200057
Grand Total	1472170

In another table, and with little other information, more complete data was given about the water network. It is not known whether this is in addition to the lengths listed in the master plan GIS tables or different.

Table 3.1-5 GIS network length.

Region	Sum of Length (m)
Baalbeck	1,484,317
North Bekaa	627,767
South Bekaa	991,504
Zahle	988,890
Grand Total	4,092,477

The pipe material included some incorrect, un-validated inputs that seem to be the result of adding different naming standards from different sources and sometimes the incorrect field data. Overall, this stresses the importance of an asset data update.

3.2 Database architecture, Layers structure and tabular data

In the following, we give the plans that show the different main layers related to water systems:

1. Springs
2. Wells
3. Pumping Stations
4. Reservoirs
5. Water Networks
6. Transmission Lines

In addition to the 7 layers related to water infrastructures, 3 generic layers are available: villages, sections and branches as per the decrees of the WE. The following figure shows the attributes/fields under each layer. Moreover, we enclosed the extracted data from each layer

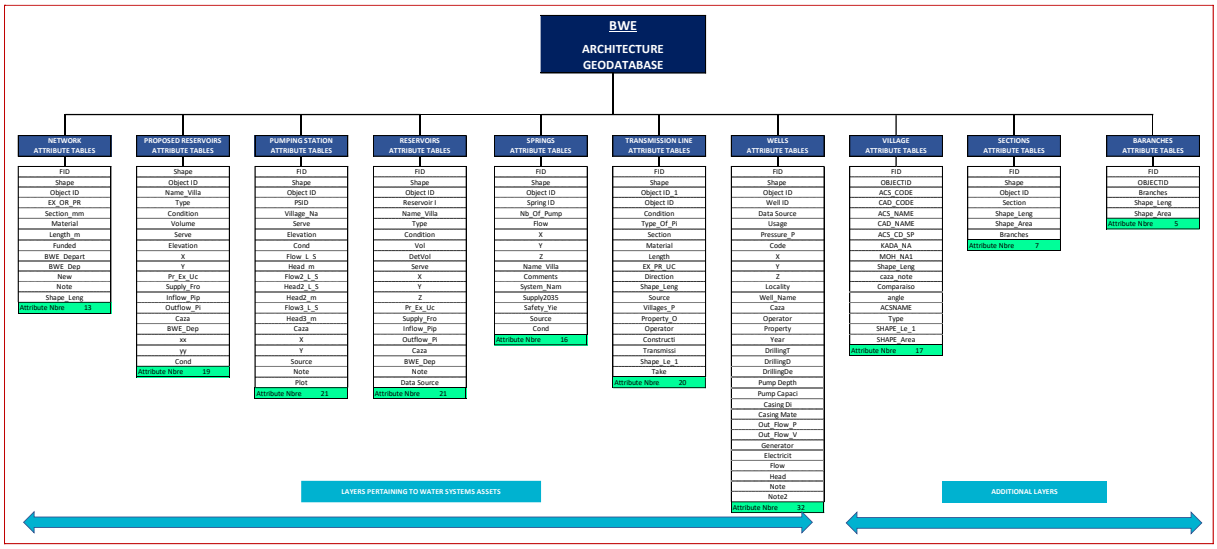

Figure 1 Architecture and structure of the GIS database and layers

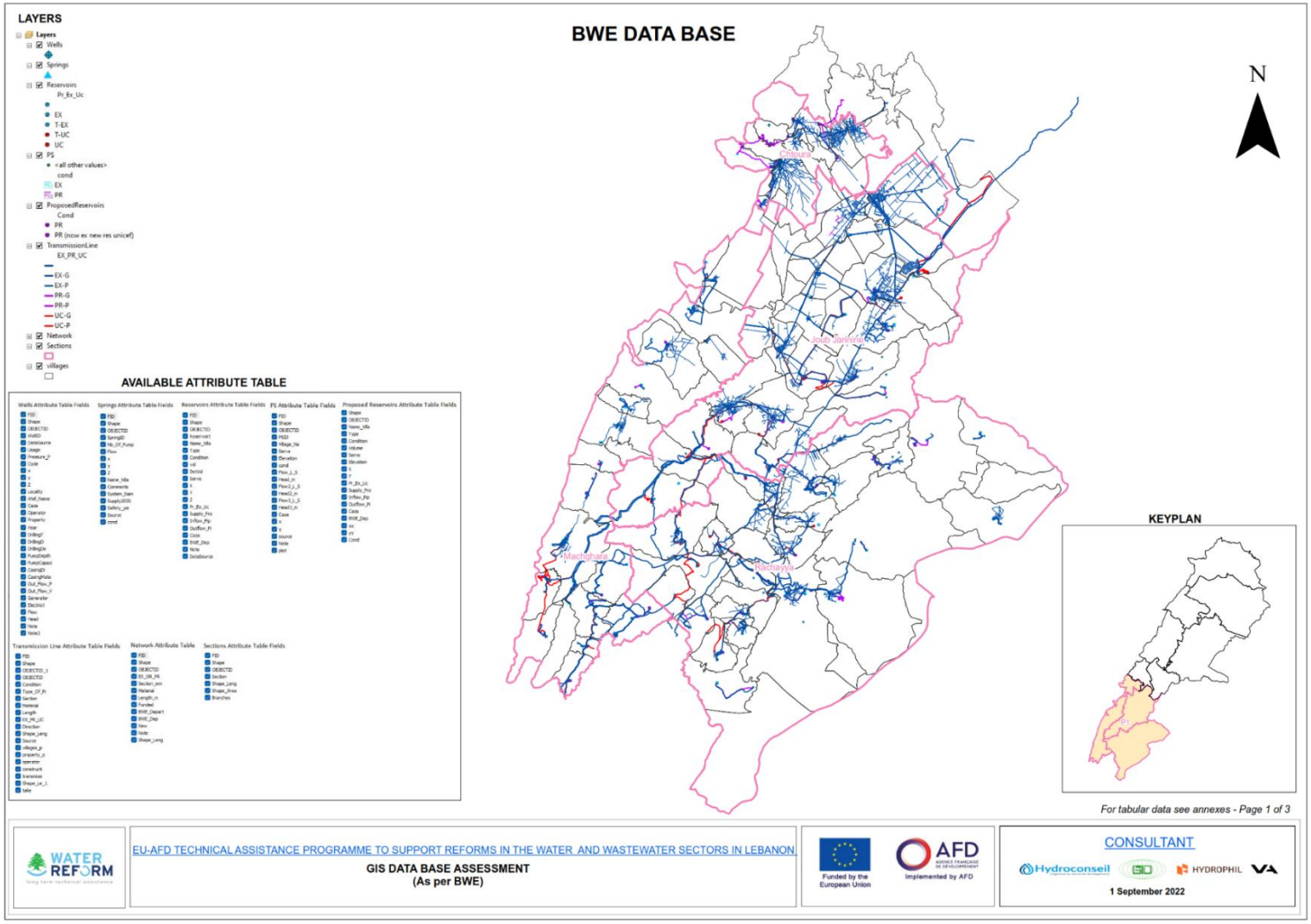

Figure 2 : Available layers and attributes as per BWE GIS Database (Southern part of Beqaa)

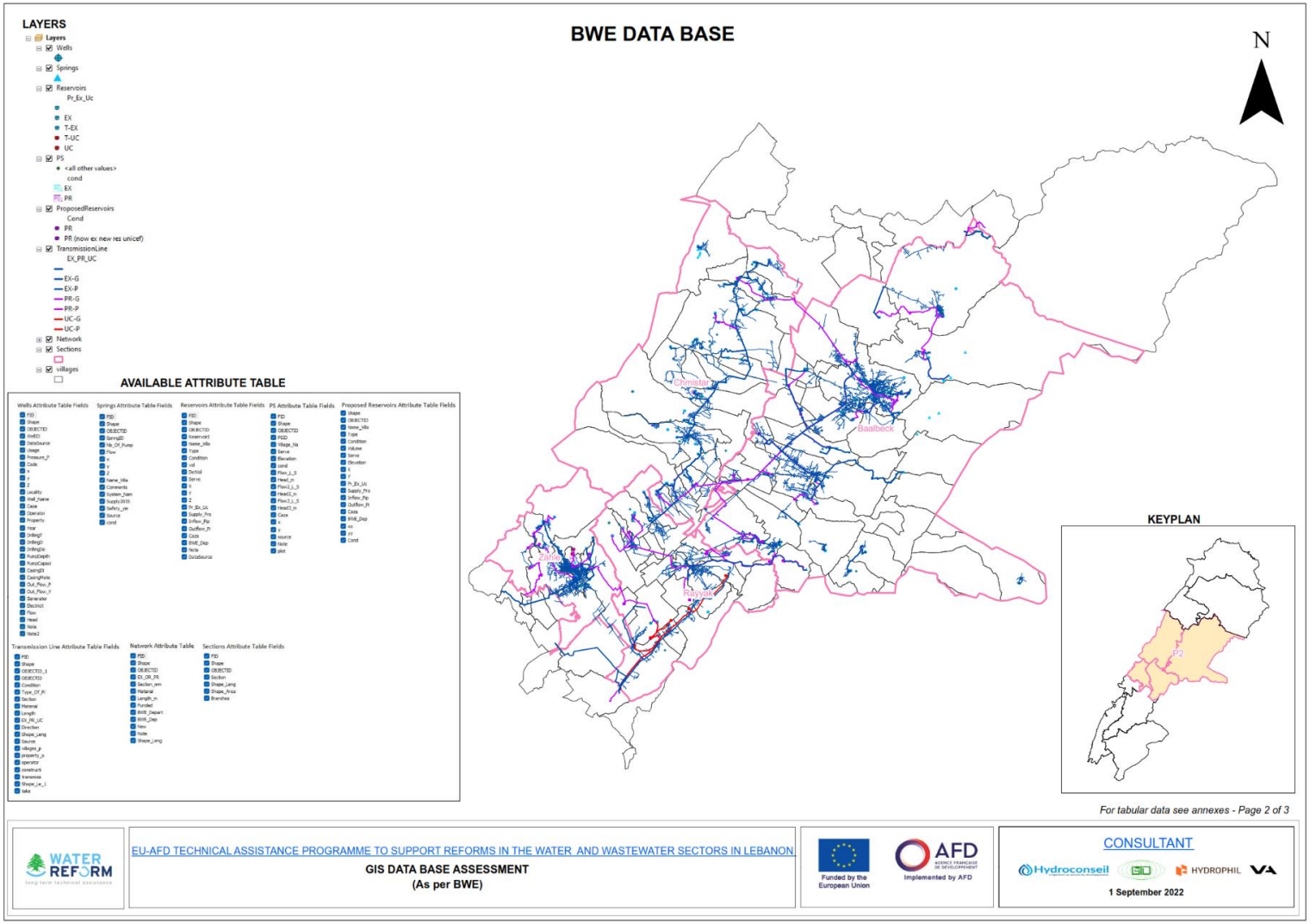

Figure 3 : Available layers and attributes as per BWE GIS Database (Middle part of Beqaa)

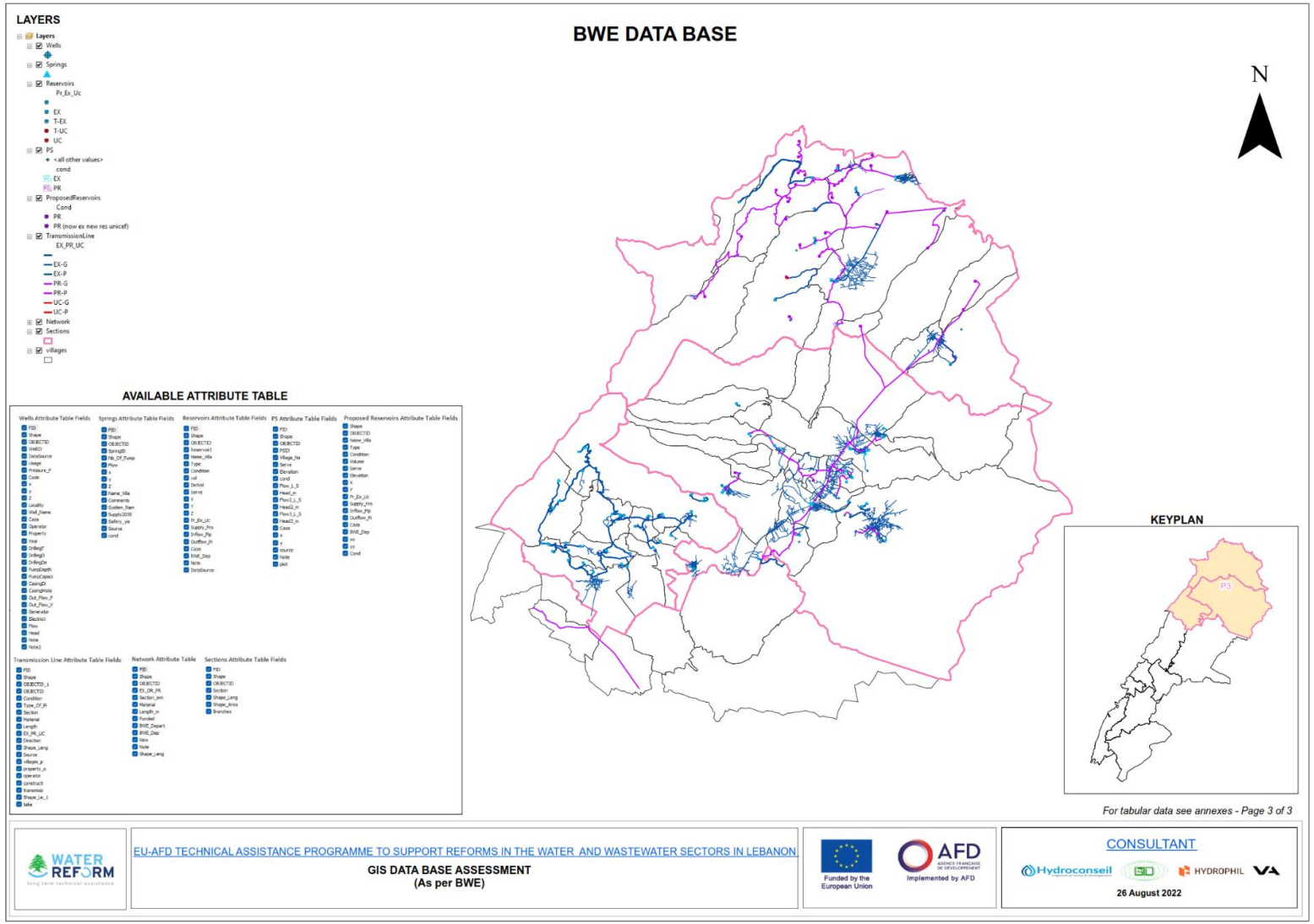

Figure 4: Available layers and attributes as per BWE GIS Database (Southern part of Beqaa)

4 BWE GIS SYSTEM ASSESSMENT

Below, we present the results assessment in terms of findings and recommendations for the BWE:

4.1 GIS IT Infrastructures

GIS server, desktop and online licences of ArcGIS were implemented under the LWP project funded by USAID. The ESRI ArcGIS Enterprise 10.7 Server /SQL 2017 and one work station were granted by the ICRC and 2 ArcGIS desktop basic version 10.3 were provided by Unicef.

Currently, the GIS server is offline and updates are sporadically carried out on a standalone machine.

The specifications, quantities of available hardware and software are detailed in Figure 5 below

BWE

1.1 INFO ON GIS SERVER OF THE WE

Server

Edition		
System		
	Processors	Intel Xeon, 128 GB, 8TB:Intel Xeon, 64GB, 5TB
	Installed Memory	13 TB
	System type	HP DL380C, HP DL380G10

Comments/ Observations

Server is stopped. And update are made locally under desktoip edition.

Proposals and Requests

No sepcial requests.

BWE

1.2 KEY FIGURES OF THE IT SYSTEM

	Available (Yes/No)	Nbr	Additional Info
IT System			
Server (Yes/No)	Yes	2	Intel Xeon
Server operation (hours)	No	-	
Workstations/Computers (Nbr)	Yes	1	Client
Software name (Arcmap, QGIS)	Yes	1	ArcGIS desktop basic version 10.3 (Unicef) ESRI ArcGIS Entreprise 10.7 Server / SQL 2017 (ICRC) ArcGIS Desktop standard version 10.5 (USAID)
Desktop license (Yes/no, Version)	Yes	3	2 ArcGIS desktop basic version 10.3 (Unicef) 1 ArcGIS Desktop standard version 10.5 (USAID)
Online License (Yes/no, Version)	Yes	1	ArcGIS Online
Licensing fees (Yes/No)	Yes		
GPS Receiver/ GIS Collector (Yes/No, Nbre)	Yes		
Plotter/Printer	Yes		

Comments/ Observations

Online version is expired.

Proposals and requests

Need to operate of the Server

Figure 5: GIS Server specifications, Software licenses

4.2 GIS Database

4.2.1 Source of the Data

The database relies on the collected and compiled data from the MP plan approved in 2015 and from other sources as new projects (collected data from CDR, NGOs and contractors). No data on interventions, metering, readings are entered in the Database.

4.2.2 Findings

Results of diagnosis and assessment pertaining to GIS Database have been split in two types of findings: general and specific.

4.2.2.1 General findings

The following summarizes the main findings as problems, gaps and upgrade needs for the WE Database.

- No database diagram, registry, user's guideline and manual has been prepared
- No procedure is adopted to standardize data entry
- The GIS database does not cover all the hydraulic systems falling within the territory of the service area of the WE
- No clear vision on architecture and structure of the data base.
- A list of problems that were identified, but not limited to:
    - Layers are not organized in a professional way;
    - Attributes are not well labelled, different units are used for the same field, duplication, repetition of fields.
    - Some attributes, are useless
    - A number of fields/attributes are without any data
    - Improper way of filling data (use of diameter instead of flow value)
    - Unverified data are used to fill the info
    - Confusion in type of data (physical and operational)
    - Problems in geometry and topology which impacts the use of data in the hydraulic models.
    - Different data sources, duplicate entries
    - Old assets not accurately recorded
    - Replacements, rehabilitation are not recorded and info of assets are not updated

  - Many old facilities, in use by locals or abandoned are not identified nor documented.
  - Confusion in ownership of public assets, Uncharted, governmental, municipal, religious, irregular use, and establishments.
  - The data base is not ready for integration with other systems as ERP and other systems

- To date, and despite several attempts, the GIS system is still considered as a pool to store data and perform some spatial analysis. The data base of the water establishment is not built on a basis to be used as planning and management tool. The actual situation can be summarized as follows:
- The data base is constructed using the collected and compiled data from the MP plan approved in 2015 and from other sources as new projects.
- The data base still need upgrade in a way to be used as management and planning tool

4.2.2.2 Specific findings

The following summarizes the specific findings pertaining to the BWE's database. They are:

- Layers related to water system assets are 7 layers. They are named as: Wells, Springs, Reservoirs, PS (Pumping Stations), Proposed reservoirs, Transmission line, Network
- Additional layers as Limits of villages, branches (4 in BWE), sections (11 in BWE)
- Data are gathered in layers/shapefiles covering the whole area under the mandate of the WE
- Data relies on the data compiled and collected within the framework of the MP of 2015.
- Codification are applied the layers of wells and reservoirs, however some of those assets are entered without codes.
- The distinction between pumping stations and wells is not clear
- The database includes info on proposed, ongoing and under construction facilities.
- Layers pertaining to transmission pipelines presents the following:
  - Duplication in many areas.

  - Gaps and lack of information in attributes of each layers (material, section, etc.)
  - No operational data pertaining to interventions, repairs, failure, etc.
  - Label does not accurately reflect the entered info
  - Units are not clearly indicated.
  - Mixing of units of flow, pipe diameters, etc.
- Age and state of most equipment is unknown
- No data on the soil, type of roads, covers, starting point, ending point, etc.
- Problems in geometry (vertices do not reflect the real alignment of the pipe)
- Connections and intersection between pipes are not well snapped.
- Alignment of pipes in many areas are drawn manually. Moreover, the alignment of pipes are taken from designed and or shop drawings and do not reflect the real path of pipes
- No layers and data on valves
- No layer, table (data/info) on housing units, customers, house connections, water meters, bulk meters, etc.
- No layers on parcels, plots
- No data on bulk meters, household's meters, customers, etc.
- No operational data as intervention, failure, leakage, pressure, flows, etc.
- In all layers we identified the following:
  - Discrepancies in the spelling and writing of the name of villages.
  - In some fields, some data is not in relation with the label
  - There no filed on the property.
  - Different fields are created for flow for the different pumps and most of them are not filled.
  - No indication of the source of water and the section of the inlet and outlet pipe
  - No info on the replacement, repairs, works, as well on the date of construction, etc.
  - Inaccurate yields provided for springs.

In the following , we propose the questionnaire for the assessment which presents details on each layers and attributes of the data base:

BWE

2 KEY FIGURES OF THE GIS DATA BASE

General (Nb of layers, Structure of the Data)	Available Yes / No	Indicator value if applicable	Comment / Observations
Coverage (% of the Service Area)	Yes (Not the whole service area)	60 to 70	Data for water systems not included in the data base shall be collected from engineering documents from contarctors/consultants and/or MoEW and CDR if any surveyed.
Source of Data	Yes	80 % from the Master plan prepared in 2015	Master plan, new implemented projects
Layers (nb , Type, etc.)	Yes	7	As data are based on the master plan, in some layers some asset are under proposed status
Codification if applied	Not all of them	2 to 3 layers	Only for reservoirs, wells but not completed for the whole asset
Topology and geometric conformity (pipe intersection, horizontal curvature, etc.)	Not all of them	30 to 40	problems, in pipe definition, intersection, alignment, Starting and end points not indicated
Layers organization (by administrative departments, systems, projects, etc.)	Yes		By asset type, need to be reviewed and add other layers
Base maps (Satellite images, TIN, DEM, Topo Maps, Land use, soil, etc.)	No		Not available, there is high need to purchase those base maps
Integration with other management tools (ERP, SCADA, Etc.)	Yes	Some tentatives	Some tentatives are made to make pilot projects as integration (Hawch Al Oumara)
Integration with hydraulic models (Water CAD, pipe risk calculation, etc.)	No	0	This shall be considered once the data base are cleaned up
Update Method (Data entry, type of data, work order, As built, shop drawings, etc.)	Yes	NA	Continuous GIS update of water/waste water /irrigation data (by implementing new projects (wells,reservoirs,networks,waste water networks,irrigation canals... to the existing Master Plan GIS data.
Database use (1. Storage, 2.Analysis, 3.Asset Valuation, 4.Management&Planning)	Yes	Not used as tool for management and planning	1, analysis , partially analyis and mangement

Water systems		Nb of Attributes	Labeling compliance	Units Compliance	Filling data compliance	Completeness (% of missing data)	Accuracy	Comment / Observations
Physical data	Wells	29	Need review and standardisation	Yes	Review and cleaning	65%	Survey and validation	Duplicate - lot of important data are missing - to add the distribution system -
	P.S.	17	Need review and standardisation	Yes	Review and cleaning	90%	Survey and validation	Missing the operating hours -
	Springs	15	Need review and standardisation	Yes	Review and cleaning	90%	Survey and validation	Missing the aquifer - the exploited yield - flow in winter or summer
	Dams	NA	NA	NA	Review and cleaning	NA	NA	There is no dams used to produce water for BWE
	Pipes							
	Distribution	13	Need review and standardisation	Need review	Need review	Survey and validation	Survey and validation	
	Transmission	19	Need review and standardisation	Need review	Need review	Survey and validation	Survey and validation	Missing the distribution system - identify the units
	Valves	NA	NA	NA	NA	NA	NA	Location of vales along with some specifications should collected and surveyed.
	Reservoirs	20	Yes	Yes	No	80%	Need survey	Duplicate of attributes - Unit not determined - missing data
Operational Data	Pressure (Static, Dynamic, data from Pressure devices, etc.)	NA	NA	NA	NA	NA	NA	Pressure should be added in order to be used to assess the hydraulic condition of pipes. This is an important information to contruct plans
	Flow (Reading, design, etc.)	NA	NA	NA	NA	NA	NA	Pressure should be added in order to be used to assess the hydraulic condition of pipes. This is an important information to contruct plans
	Failure/Breaks/Intervention (work order, localization from GPS, GIS collector, etc.)	NA	NA	NA	NA	NA	NA	Pressure should be added in order to be used to assess the hydraulic condition of pipes. This is an important information to contruct plans and DMA.
	Water Quality (Results of tests are integrated and updated?)	Need review	Need review	Need review	Need review	Need review	Need review	Executed under GIS (water quality mapping). Need review and to be integrated in the same database
	Others							Mapping of projects under execution and proposed

Spatial data & Other Data	Available Yes / No	Percentage Coverage	Issued date	Source of data	Accuracy	Comment / Observations
Villages names (source, code)	Yes	ALL the service area	NA	CAS	NA	Limits of some villages need to be reviewed. Some areas are not assigned to villages called "conflict areas"
Cadastral data (village limits, administrative department, water systems)	Not all of them	Only a part of villages	NA	NA	NA	This data shall be collected/Purchased from the concerned authority. It is important to have updated data on propriety and public domaines which facilitate the implementation of new projects
Population/Housing units (Source, census, etc.)	Yes partially	ALL the service area	2013	CAS	Need to be updated	It is an essential data for the WE to estimate the demand and the water balance for each water system
Satellite images	NA	0	NA	NA	NA	Purchase/Collect
DEM/Contours/Tin	NA	-	NA	NA	NA	Purchase/Collect

Figure 6: Sample of assessment questionnaire

Customers and population data	Available Yes / No	Percentage Coverage	Last update	Source of data	Accuracy	Comment / Observations
Customers	Not included	90,000	ncluded and georefere	ERP	The data provides generic info.	Need survey and geolocalisation
Water meters and Gauges	No	34,000	ncluded and georefere	ERP	The data provides generic info.	Need survey and geolocalisation
Readings	Yes some of them	Not collected and included in GIS	NA	ctors for a certain period of	Outdated	Some customers location are available Some GIS layers and data corresponding to the water monitoring Data Base.
Water meters	Yes some of them	Not collected and included in GIS	NA	ctors for a certain period of	Outdated	
Bulk meters	Yes some of them	Not collected and included in GIS	NA	ctors for a certain period of	Outdated	
Housing units (census, CAS, etc.)	Yes for some areas	Yes for some areas	NA	CAS, GIZ, World Bank	Outdated	
Population (census, CAS, etc.)	Yes	Whole areas	2,009	CAS, GIZ, World Bank	Need to be redone	

Water management tools	Available Yes / No	In use Yes / No	Comment / Observations
Network analyst,Water Gems, Water CAD	Yes	Not used	Need to upgrade and clean the data in order to be used
Risk analysis tool (Failure assessment and forecasting)	No	Not used	Need to collect the data on age and date of installation
Asset Water management tool for incitement planning	No	Not used	Too early, the database is still not ready to carry out asset water management

Summary of diagnosis

The quick assessment of the GIS database allows to conclude the following
- Problems in the structure and architecture of the GIS database
- Layers are not well defined (missing data, not filled in a systematic way, accuracy)
- Length of pipes are the length generated in the GIS, there no indication to the 3D length.
- Problem in the geometry of pipes (shape, duplication, alignment, connection, missing of starting and end points)
- Layers includes existing and proposed assets.
- Operational data as pipe failure, burst, pressure, velocity, etc are missing and no fields created to addd the info.
- Labelling is not well done and units are not clear and there is mix of different unit for same field.
- Housing units, population, subscribers, readings, valves, operational data, diameter, material, etc are not available and need to prepare an SOP to collect these data and others to be defined during the detailed assessment of the GIS system.

Available manual Guideline

Not available. There is high need to prepare an SOP for the GIS Database.

Recommendations and proposed Actions

As result of the assessment, the following actions are requested to set out a proper GIS system:'

Priority 1 (Target: Correct the data base; Time frame: 1 year):
- Standerdize the structures of layers, attributes, labelling, units.
- Collect data from other sources as CDR, MoEW, municipalities, contractors and consultants to complete the asset (pipes and the associated structures,wells, P.S., Springs, reservoirs)
- Update layers according to the compiled data and carry out validation for reservoirs, wells and springs
- Correct where possible the geometry of pipelines and complete the missing data as diameter, material.
- Add data as age, date of installation, etc. to calculate the risk of failure in later stages
- Add layer on bluk meters, valves, etc
- Purchase/collect recent satellite images, DEM, Topo maps, Contours lines.
- Purchase/collect cadastral maps for the area of beqaa
- Collect data on roads, soil and landuse

Priority 2 (Target: Upgrade the data base; Timeframe:2 years):
- Conduct Asset survey and data validation
- Assign code for each asset
- Conduct housing units and subscribers census and a create GIS customer Data Base
- Add data on customers, water meters, readings, etc.
- Add operational fields as pressure, flows, failure, bursts on pipe to be used in the risk analysis of pipe
- Add fields and attributes in a way to prepare the data base for integration with others systems as ERP (Enterprise resource planning), SCADA, MMS, Water Quality system, Call center.
-

Priority 3 (Target: Use the database as asset mangemet tool; Timeframe: 1 year):

- Integrate the GIS with other hydraulic tools as WaterGEMS, risk failure tool and other operational data as production volume, distributed volume, pressure and leakage, etc to define DMAs and plan future interventions

Figure 7: Sample of assessment questionnaire

Regarding the data available on wastewater systems, the database consists of only two layers:

- WWTP
- Wastewater networks

The study of these 2 layers indicates the following:

- Lifting pipes, gravity pipes (collectors and branches), house connections are under the same layers
- Pipes data is not up to date.
- The available data does not cover the entire area under the mandate of the WE
- The attributes available are only the physical information and in the most of time they are not complete
- No data on manholes, lift stations
- Data on WWTP are not up to date and complete and does not include data for all WWTPs falling within the service area of BWE
- No operational data
- No clear architecture and structure of the database

As a conclusion, the wastewater database needs to be reconstructed and standardized.

4.2.3 Recommendations

The ultimate goal of the GIS upgrade is to set out a tool for short term and strategic planning. To attain this goal, recommended actions would be implemented in 3 phases.

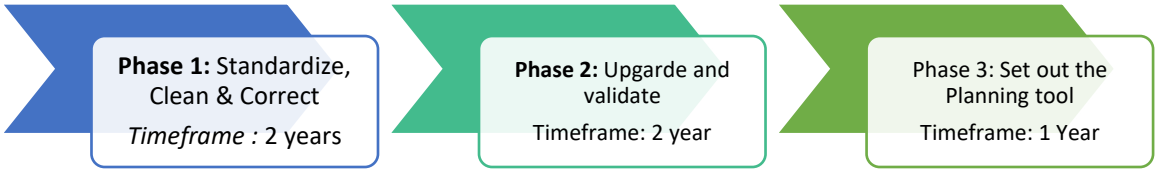

Figure 8: Flowchart shows the 3 phases to set out a GIS system

Below is a list of tasks to carry out in order to meet the objective set out for each phase:

Phase 1: Objective: Correct the data base - Time frame: 2 years

- Prepare the database diagram, registry, user's guideline and manual
- Describe the procedure for entering data
- Standardize the structures of layers, attributes, labelling, units,
- Collect data from other sources as strategy, CDR, MoEW, municipalities, contractors and consultants to complete the asset inventory (pipes and the associated structures, wells, P.S., Springs, reservoirs)
- Update layers according to the compiled data and carry out validation for reservoirs, wells and springs
- Correct where possible the geometry of pipelines and complete the missing data as diameter, material
- Add data as age, date of installation, etc. to calculate the risk of failure in later stages
- Add layer on bulk meters, valves, etc.
- Purchase/collect recent satellite images, DEM, Topo maps, Contours lines.
- Purchase/collect cadastral maps for the area of Beqaa
- Collect data on roads, soil and land use

Phase 2 Objective: Upgrade and validate - Timeframe: 2 years

- Conduct Asset survey and data validation
- Assign code for each asset
- Conduct housing units and subscriber's census and a create GIS customer Data Base
- Add data on customers, water meters, readings, etc.
- Add operational fields as pressure, flows, failure, bursts on pipe to be used in the risk analysis of pipe
- Collect the available data on pressure, flows, failure, bursts on pipe to be used in the risk analysis of pipe

- Add fields and attributes in a way to prepare the data base for integration with others systems as ERP (Enterprise resource planning), SCADA, MMS, Water Quality system, Call center.

Phase 3 Objective: Setting out - Timeframe: 1 year

- Integrate the GIS with other hydraulic tools, risk failure tool and other operational data as production volume, distributed volume, pressure and leakage, etc. to define DMAs and plan future interventions.

5 ALLOCATED STAFF

In the following, we propose the questionnaire for the assessment which presents details on staff, the requests and actions to be taken:

	Nbr	Additional Info	Comments
GIS Staff			
Total allocated Staff	1		Only one person
Permanent Staff	-		No unit on the organisation structure
On Demand Staff	1		
Education	Engineer		
Skills	Good		
Level	Very Good		
Comments / Observations			
The allocated person has other tasks in parallel to GIS. There is no support from other employees.			
Proposals and requests			
Creation of GIS unit The role of this unit shall cover the following: - Data collection, data entry, survey and validation - Maintain the data up to date - Integartion of the GIS system with other systems - Data analyis and preparation of intervention and plan with full coordination with other hydraulic departments (needed staff +needed software and hardware +Data Collection…+Satellite images +cadastral maps). *Recruitement of staff* - Hire 2 contractual technician for 2 years			
Option	**Available Yes/No**		**Comments / Observation**
Need to trainings	No		Once the technicians are recruited
Needs to expert staff	Yes		1 For short term mission (2 to 3 months)
Needs to support Staff (Nbr/level)	Yes		2 Technicians for survey and data entry (2 years contracts)

Figure 9: GIS staff assessment at BWE

It is of great interest to point out that GIS staff are not expected in the diagram of the BWE. Currently, 1 staff member is seconded to the WE and does not work full time for GIS activities.

As an important step for the development and the maintenance of the GIS database is to recruit staff with different skills and levels in relation to GIS, as surveying, Geomatics, programming and data collection, and also to create a unit for GIS activities and tasks.

6 NEXT STEPS TO IMPLEMENT THE RECOMMENDED ACTIONS

- Prepare a TOR to appoint a GIS expert for short mission to thoroughly examine, and in full coordination with the LTTA team, especially the team leader and the operations expert, each GIS database in a way to define the need to complete, revise and upgrade the structure, validate and standardize the existing data base. In addition to this, the expert shall prepare a guideline/SOP for the GIS database.
- The awarded GIS expert shall prepare a guideline/SOP for data entry, data base standardization in terms of architecture, structure layers and attributes table. Moreover, the consultant shall prepare a simplified model for the integration of the GIS system with other systems as SCADA, ERP, MMS, etc.
- Prepare a TOR to recruit GIS support staff to be based at each WE to work on data collection, upgrade, correction and validation.