Republic of Iraq

Ministry of Water Resources

General Directorate for Water
Resources Management

Strategy for Water and Land Resources in Iraq

Guidance Note Series

Geographic Information System and Databases Strategy for Developing Planning Tools

GN 02

August 2006

GN 02 Rev 0

This document was prepared under the Agriculture Reconstruction and Development Program Strategy for Water and Land Resources in Iraq Component (RAN-C-00-4-00002-00) by Development Alternatives Inc, August 2006.

This document is one of a series of occasional guidance notes published by the Ministry of Water Resources addressing issues relevant to strategic planning for the sustainable use of the water and land resources of Iraq.

The guidance note describes the strategy for further development of GIS and databases prepared by the consultants in collaboration with Mr Mudher of the Ministry of Water Resources GIS Section.

Preliminary

Report Issue and Revision Record

Rev	Date	Description
P1	August 2006	Preliminary when Phase 1 curtailed

List of Contents

Page

Chapters and Appendices

1	Introduction	1
2	Standardisation of Software	2
3	GIS Standards and Structure	2
4	Data Exchange Mechanisms	4
5	Reliability of Data	4
6	map products for planners	4
7	Evaluating Training Needs	4
8	Evaluating Hardware and Software	5
9	Developing Mutual Professional Support Mechanisms	5

Appendix A	Suggested Map Products	A-1

Preliminary

Acronyms

ARDI	Agricultural Reconstruction and Development in Iraq project
GIS	Geographic information system
IT	Information technology
MoWR	Ministry of Water Resources
SWLRI	Strategy for Water and Land Resources in Iraq
USAID	United States Agency for International Development

Computer Software Packages and Specialist Terminology

ArcGIS	GIS software from ESRI
Claromentis	Web-based collaboration system from Claromentis Ltd
HEC-ResSim	Reservoir operation software from the HEC
SQL	Standard Query Language
WMSM	Water management system model for Iraq built using HEC-ResSim

Preliminary

1 INTRODUCTION

1.1.1 Maps and GIS tools are extremely important in strategic planning. Not only are they actively used by the planners but they are a vital component of the extremely important task of selling the resulting plans to others: politicians, other ministries, and the general public.

1.1.2 At the start of the SWLRI project in July 2005 GIS capacity was limited to a few small centres, the largest of which was the GIS Section within the MoWR. From the start the SWLRI team have emphasised the value of using maps and GIS tools to assist in strategic planning work. In February 2006 the first GIS Cluster meeting was held with representatives of 11 ministries in Erbil to raise awareness of the potential of GIS tools and to start a collaborative process by which all ministries contributing to SWLRI Phase 1 would develop their GIS capability and move towards adoption of common standards to facilitate future exchange of data.

1.1.3 This document presents a strategy for developing and maintaining a suite of GIS tools and map products for use by the SWLRI Unit, and for establishing formal mechanisms for sharing expertise and exchanging data.

1.1.4 The strategy addresses the following topics:

- Agreement on standard software
- Appropriate structure for information
- Identification of data exchange mechanisms and quality control processes to ensure the reliability of data being exchanged
- Evaluating training needs at each of the participating ministries
- Evaluating hardware and software needs at each ministry
- Developing mutual professional support mechanisms.

Preliminary

2 STANDARDISATION OF SOFTWARE

2.1.1 The data being collected by and on behalf of the SWLRI Unit needs to be arranged in a structured predefined manner. The MoWR standard software is ArcGIS from Esri software. This is a comprehensive suite of applications that has gained worldwide recognition and is in use in many government organisations in many countries.

3 GIS STANDARDS AND STRUCTURE

3.1.1 Geo-referenced information held within ArcGIS is generally held in the following formats:

1. Shape Files. These are individual data layers that are stored as points, lines or polygons. Shape files generally comprise one type of information for instance well locations could be stored as points; agricultural areas could be stored as polygons.
2. GeoDatabases. These are effectively collections of shape files contained within a Microsoft Access (Jet) or SQL database. Again, these may comprise point, line or polygon information. Geodatabases allow GIS administrators to create complex interrelations between datasets and aid in the management of the GIS system.
3. Raster Data Sets are usually large data files containing information such as satellite or aerial photography or map scans.
4. Databases with a Geo-referenced component. Access, SQL or another database source can contain data such as latitude and longitude. Generally used to store point information, the coordinates are usually stored in decimal degrees.

3.1.2 All of the above information has to be based on a standard projected coordinate system. Most of the data within Iraq has so far been projected to WGS 1984 UTM Zone 38N. Iraq actually covers 37N, 38N and 39N, and it is possible to use all projections within ArcGIS files, but it does introduce a level of complexity that may lead to a number of errors if not administered correctly. 38N covers Baghdad and is a very good compromise projection for all information. This standard has to be agreed by all ministries, not least those in Erbil and Sulymaniyah, who lie outside of the 38N area.

3.1.3 Storage locations and naming conventions are important too when producing a GIS strategy. These need to be formulated before construction of the databases commences. The structure of the GIS system is very important. A suggested structure is to arrange data by function rather than ministry or information storage method. Water based GIS systems developed in other countries have divided the information up into five areas:

1. Supply sources, or available resources, layers. These comprise features such as river diversion points, wells, desalination plants, imported water, water treatment plants. These layers are usually point or polygon features within geodatabases.
2. Demand centres layers. These comprise features such as population centres, industrial areas, forestry, agriculture and exported water. Power stations and

Preliminary

dams are also to be included within these layers. As with supply layers, these layers are usually point or polygon features within geodatabases.

3. Conveyance layers. These comprise features such as canals, drains, water pipelines both for supply and for waste. These layers are usually line features within a geodatabases.
4. Geographic inventory layers. These layers comprise information such as river/lake and sea, rainfall distribution and soil areas. These layers are usually utilised when performing analyses or creating comprehensive maps for use in areas such as agriculture or transportation. These layers are invariably stored as polygon or point survey information.
5. Source data layers. These comprise source information and are usually utilised when building up the previous 4 layer types. These layers could be satellite information of varying type, aerial photography or scanned survey maps. These are usually stored as raster information, manipulation and editing of these layers is difficult, so they are usually used for reference.

Preliminary

4 DATA EXCHANGE MECHANISMS

4.1.1 At the start of SWLRI there was a considerable variation in the extent of digital GIS usage between ministries with the MoWR being in the vanguard. The methods of data exchange being developed between SWLRI and the ministries must therefore provide for both electronic and paper formats, and the flexibility to change as GIS usage becomes more widely adopted with time.

5 RELIABILITY OF DATA

5.1.1 By adopting generic standards for data quality control the ministries can ensure that all spatial information being exchanged is reliable having passed through a number of checking procedures with the originating organisation.

5.1.2 The generic standards should be developed by the MoWR GIS Section which has already considerable experience of creating and maintaining GIS products. They should then be disseminated through the mechanism of the Cluster Meetings.

5.1.3 Other ministries should then review the generic procedures and compare them to existing procedures used by their technical staff. They should then develop their own local ministry standard procedures and disseminate them to other participants through the Cluster Meetings.

6 MAP PRODUCTS FOR PLANNERS

6.1.1 It is most important that the GIS specialists in the various ministries maintain a regular dialogue with the planning staff both within their own ministry and with the SWLRI Unit. The needs of the end users must be the driver for the GIS work.

6.1.2 Preparing geo-databases can be very time consuming and it is therefore important that the GIS work is prioritised so that the most urgently needed products can be delivered to the planners as quickly as possible. Part of the dialogue with the end users should be about the time frame for delivery and the resources needed to complete the activity.

6.1.3 Some suggested map products that would benefit the SWLRI Unit are listed in Appendix A.

7 EVALUATING TRAINING NEEDS

7.1.1 Capacity building in GIS at each of the participating ministries is an important part of the development of strategic planning activities.

Preliminary

7.1.2 The initial GIS Cluster meeting in Basra raised the issue of training for GIS staff. Many of the ministries have software and hardware but have few or no trained staff. It was suggested that an introductory course on GIS would be valuable to several of the ministries.

7.1.3 A second higher level of GIS training for MoWR themselves would also prove beneficial. The MoWR GIS department is already ahead of other ministries in its capabilities, and SWLRI provides it with a new remit to deliver its services to others outside its own ministry. A role of this type requires a highly effective team of well trained GIS professionals that are able to deliver accurate mapping information at a high rate. Advanced GIS training courses would certainly facilitate this.

7.1.4 During SWLRI Phase 1 a number of courses were held and the lessons learned should be fed back via the Cluster Meetings to allow for continuous improvement of the training opportunities.

7.1.5 Training needs and the merits of particular forms of training should be re-evaluated every year.

8 EVALUATING HARDWARE AND SOFTWARE

8.1.1 For some ministries the issues are what equipment and software are required to set up a GIS section, for others such as MoWR the issue is of keeping abreast of improvements in technology and software versions.

9 DEVELOPING MUTUAL PROFESSIONAL SUPPORT MECHANISMS

9.1.1 The Cluster Meetings have played an important role in bringing GIS professionals and those with an interest in taking up the subject together to focus on raising standards in map and GIS products. These should be continued and held quarterly.

9.1.2 A technical discussion forum should be established on Claromentis so that ministries' GIS and other interested parties can develop question and answer postings to share knowledge around the group.

9.1.3 The valuable centre of expertise at the MoWR should be exploited by other ministries for ongoing technical support. This may require financial arrangements to be agreed between ministries and the MoWR.

9.1.4 Iraqi experts in GIS such as Mr Mudher of the MoWR should be used where appropriate to lead training courses.

Preliminary

Appendix A Suggested Map Products

This appendix contains a list of some of the map products that would be useful for the activities of the SWLRI Unit. It is indicative only and is intended to prompt the GIS teams in the various ministries, and particularly that of MoWR, to put forward additional ideas for map products for the SWLRI Unit to consider.

Map product and suggested use	**Layers needed**
Agro-climatic zones and irrigated areas *To determine which set of crop water requirements to use for a particular irrigation area*	National borders
	Governorate boundaries
	Main rivers
	Lakes
	Reservoirs
	Sea
	Major town names and scaled symbol
	Irrigation scheme boundaries – formal schemes
	Irrigation area boundaries - traditional
	Agro-climatic zones (General Scheme Stage 2)
Iraq WMSM computation points and irrigated areas *To determine which irrigated areas are associated with which WMSM computational point when preparing scenarios*	National borders
	Governorate boundaries
	Main rivers
	Lakes
	Reservoirs
	Sea
	Major town names and scaled symbol
	Irrigation scheme boundaries – formal schemes
	Irrigation area boundaries - traditional
	Main canals
	Main drains
	Dams
	Barrages/weirs
	Pumping stations (irrig & drainage)
	Nodes and other computation points in ResSim
Hydrometric network and/or water quality monitoring network *To show where monitoring takes place. Could add Nodes for ResSim layer to show where calibration points fit with the model structure*	National borders
	Governorate boundaries
	Watersheds (main river basins)
	Main rivers
	Lakes
	Reservoirs
	Sea
	Major town names and scaled symbol
	Dams
	Barrages/weirs
	River gauging stations
	Water quality routine monitoring sites
Climate monitoring network *To show where monitoring takes place. Could add layers for any climate parameter, eg:* *Average annual rainfall, temp etc*	National borders
	Governorate boundaries
	Watersheds (main river basins)
	Main rivers
	Lakes

Preliminary

Map product and suggested use	**Layers needed**
Average winter season rainfall, temp etc *Average December rainfall, temp etc* *Or one of the agro-climatic zone layers*	Reservoirs
	Sea
	Major town names and scaled symbol
	Raingauges
	Climate stations
	Agro-meteorological stations
Groundwater monitoring network *To show where monitoring takes place*	National borders
	Governorate boundaries
	Main rivers
	Lakes
	Reservoirs
	Sea
	Geological formations
	Hydrogeological characteristics
	Major town names and scaled symbol
	Piezometers
	Water quality routine monitoring point
Monitoring within irrigated areas *To show where level/flow and water quality are monitored within the canal and drain networks to assess water use and return flows*	National borders
	Governorate boundaries
	Watersheds (main river basins)
	Main rivers
	Lakes
	Reservoirs
	Sea
	Major town names and scaled symbol
	Irrigation scheme boundaries – formal schemes
	Irrigation area boundaries - traditional
	Main canals
	Main drains
	Dams
	Barrages/weirs
	Pumping stations (irrig & drainage)
	Level/flow gauging stations
	Water quality routine monitoring sites
Hydropower schemes (existing and proposed)	National borders
	Governorate boundaries
	Main rivers
	Lakes
	Reservoirs
	Sea
	Major town names and scaled symbol
	Dams
	Barrages/weirs
	Hydropower installations
Water supply and sanitation infrastructure	National borders
	Governorate boundaries
	Main rivers
	Lakes
	Reservoirs
	Sea
	Major town names and scaled symbol

Preliminary

Map product and suggested use	Layers needed
	Water Treatment Plant
	Area served by each WTP
	Wastewater Treatment Plant
	Area served by each WwTP
Groundwater development *Could be combined with a layer showing water table depth*	National borders
	Governorate boundaries
	Main rivers
	Lakes
	Reservoirs
	Sea
	Geological formations
	Hydrogeological characteristics
	Major town names and scaled symbol
	Boreholes
	Water wells
	Springs
Irrigated agricultural production by crop and by governorate *Could show other crops, other seasons, average over last 5 years, individual years* *Could show rainfed agricultural production by crop and by governorate and could add layer for season rainfall amount*	National borders
	Governorate boundaries
	Main rivers
	Lakes
	Reservoirs
	Sea
	Major town names and scaled symbol
	Cultivated area – wheat (winter season)
	Harvested area – wheat (winter season)
	Yield – wheat (winter season)
	Production weight – wheat (winter season)
	Production value – wheat (winter season)
Irrigated agricultural production by crop and by scheme or area *Could show other crops, other seasons, average over last 5 years, individual years*	National borders
	Governorate boundaries
	Main rivers
	Lakes
	Reservoirs
	Sea
	Major town names and scaled symbol
	Irrigation scheme boundaries – formal schemes
	Irrigation area boundaries - traditional
	Cultivated area – wheat (winter season)
	Harvested area – wheat (winter season)
	Yield – wheat (winter season)
	Production weight – wheat (winter season)
	Production value – wheat (winter season)
Map of saline or water logged soils *Could combine with crop yield to show where soil conditions restrict yield compared to other areas*	National borders
	Governorate boundaries
	Main rivers
	Lakes
	Reservoirs
	Sea
	Soil type
	Major town names and scaled symbol
	Irrigation scheme boundaries – formal schemes

Preliminary

Map product and suggested use	Layers needed
	Irrigation area boundaries - traditional
	Piezometers
	Water quality routine monitoring point
Navigation infrastructure *Could combine with a layer showing volumes of traffic or weight of cargo transported*	National borders
	Governorate boundaries
	Main rivers
	Lakes
	Reservoirs
	Sea
	Navigable river reaches
	Major town names and scaled symbol
	Locks
Areas where no development can take place	National borders
	Governorate boundaries
	Main rivers
	Lakes
	Reservoirs
	Sea
	Major town names and scaled symbol
	Protected areas (environment)
	Restricted areas
	Cultural / heritage sites

Note: The list above is far from exhaustive.

Preliminary