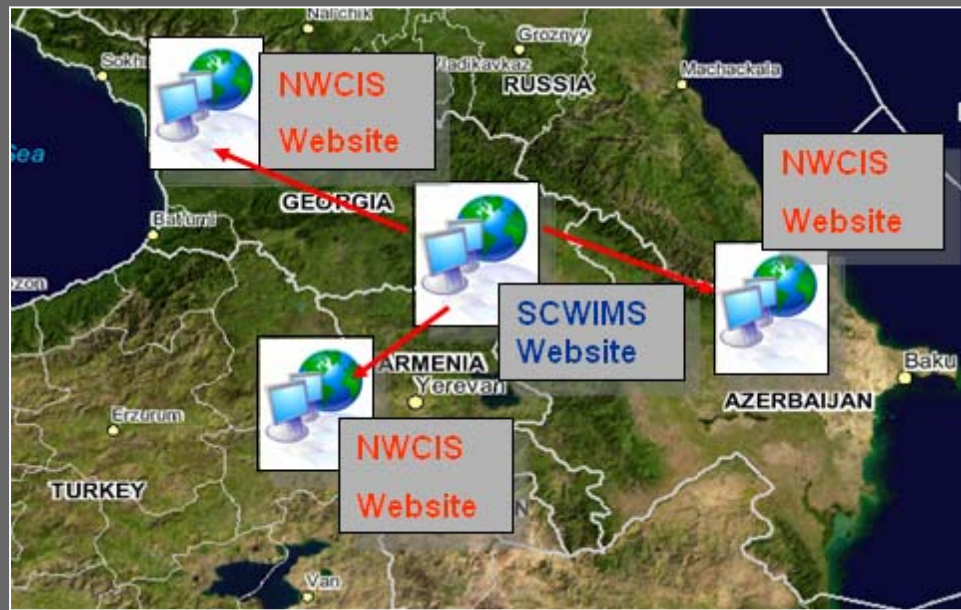




USAID
FROM THE AMERICAN PEOPLE

DESIGN OPTIONS FOR THE SOUTH CAUCASUS WATER INFORMATION MANAGEMENT SYSTEM

SOUTH CAUCASUS WATER PROGRAM
CONTRACT NUMBER EPP-I-00-04-00025-00



October 2007
Prepared for: USAID/Caucasus
Prepared by: PA Government Services Inc. and subcontractors: CADI

Table of Contents

List of Acronyms	iii
1. INTRODUCTION	1
Goal of the Project	1
Objective of Component 2	1
2. PURPOSE	3
3. SCWIMS SYSTEM ARCHITECTURES	4
Information System Architectures	4
SCWIMS Design Options	4
4. DEVELOPMENT OF THE SOUTH CACUSUS WATER INFORMATION MANAGEMENT SYSTEM	6
SCWIMS Geodatabase	6
SCWIMS Tabular Database	7
Linking Tabular Water Data to a Geodatabase	7
5. PARTICIPANTING ORGANIZATIONS	8
6. RECOMMENDED INFORMATION TECHNOLOGIES and DATA SHARING GUIDELINES	9
Appendix A. Spatial Data Organization	10
Appendix B. Data Management, Coordination and Sharing Guidelines	19

List of Acronyms

DBMS	Database Management System
DEM	Digital Elevation Model
GCS	Geographic Coordinate System
GIS	Geographical Information System
NGES	National Geological Exploration Service, Azerbaijan
MENR	Ministry of Ecology and Natural Resources, Azerbaijan
MEPNR	Ministry of Environmental Protection and Natural Resources, Georgia
MNP	Ministry of Nature Protection, Armenia
MS	Microsoft Corporation
NWC	National Water Cadastre
SQL	Structural Query Language
SCWIMS	South Caucasus Water Information Management System
SWCIS	State Water Cadastre Information System
URL	Uniform Resource Locator
UTM	Universal Transverse Mercator
WGS 1984	World Geodetic System of 1984
WAN	Wide Area Network
WMP	USAID Program for Institutional and Regulatory Strengthening of Water Management, Armenia
WRP	Water Resources Protection Division, Department of Integrated Environmental Management, Ministry of Environmental Protection and Natural Resources, Georgia
WRMA	Water Resources Management Agency, Ministry of Nature Protection, Armenia

1. INTRODUCTION

This report was prepared in accordance with Task 2.1: Develop Scientific Capacity of Water Agencies to Promote Better Management of Data Flow and Introduce the National Water Cadastre Information System in the Three Countries under Component 2 of the USAID funded South Caucasus Water Program, EPP-I-00-00025-00, Task Order 01.

Goal of the Project

The goal of this project is to increase effective and sustainable regional cooperation in the management of shared water resources. To achieve this goal, the program has the following objectives:

- To strengthen the institutional framework and capacity for trans-boundary basin management and increase technical understanding of key topics.
- To develop the scientific and analytical capacity needed to turn data into information, and promote its use for management.
- To strengthen civil society participation to achieve stewardship and measurable social, economic, and environmental results.
- To promote regional and international discussions and cooperation between Armenia, Azerbaijan, and Georgia on water management issues that are critical to the southern Caucasus.

Objective of Component 2

The objective of Component 2 is to bring the three countries up to the same level of equipment and training to meet the needs of basin-wide planning/permitting or transboundary cooperation, and to improve basic water flow, quality, and discharge data, which is currently insufficient for decision making according to international standards.

Progress in developing the basic architecture of Water User Permitting and Water Discharge Permitting in Georgia and Azerbaijan had been achieved, thus meeting the needs of the three South Caucasus countries to monitor and enforce water abstractions and discharges. Hardware has been procured for the three countries with emphasis in bringing Georgia and Azerbaijan to the same level of equipment as Armenia. The water organizations that will host equipment installations and train personnel have been identified in Georgia and Azerbaijan. While progress has been made to improve the hydrological, meteorological and water quality monitoring systems of the three countries, much work remains to be done during Year 3 to bring the systems and personnel to full compliance with international standards.

Task 2.1 was conceived and designed to ensure that the three cooperating countries have similar capabilities to enable them to undertake modern practices of water resources management and to develop compatible systems for managing the joint water resources of the region. The Task will focus on activities leading to common practices, setting common goals, and establishing common data management methodologies and techniques among the three cooperating nations so that joint efforts at water resources management can be conducted with greater facility.

One of the Task 2.1 activities was to facilitate effective data exchange between the three countries through a South Caucasus Water Information Management System (SCWIMS).

The information system will be designed and constructed to share regional spatial and tabular information. Mutual confidence required for transboundary cooperation will be created through this type of system. Building the SCWIMS with full participation from all three countries and a number of best practices will be a part of this activity.

2. PURPOSE

The main propose of the SCWIMS is to serve as a regional water resources information system by providing data/information from the three cooperating nations at a single site. The system provides users with a friendly interface and portal to information that will support transboundary basin water management decision making. The SWCIS will include both administrative and technical water resources information plus dynamic mapping applications for the region using Internet map services.

Through the SCWIMS, it is anticipated that the program will:

- Strengthen the institutional framework and capacity for trans-boundary basin management and increase technical understanding of key topics.
- Build a common understanding via a systematic and integrating framework for modeling, visualizing, and sharing geo-referenced water resources information
- Develop a closer relationship with people in other organizations, thereby reducing redundancies in data and data collection.
- Foster understanding between parties as they gain insight into the manner in which each is using the data and the information that is important to them.
- Benefit the citizens in the region as the three governments will have more accurate data with which to make faster, more informed decisions about situations that impact them

3. SCWIMS SYSTEM ARCHITECTURES

The SCWIMS will leverage the water cadastre information systems in the three cooperating countries. Based on program experience in the region, a Web-based, map-driven information management system will form the backbone of the regional-scale system. This architecture will enable gradual escalation of joint access to information stored at a regional level commensurate with progress building trust and confidence between the three countries. It also will ensure that SCWIMS resources are stored and managed first at the national level on the water cadastres, and will thus contribute to long-term sustainability and inter-operability of the regional system.

Information System Architectures

The architecture of the SCWIMS is greatly influenced by the underlying data and computer systems on which the DBMS software runs. Centralized DBMS can be client-server based, where one server machine contains all the water resources data from the three cooperating countries and executes work on behalf of multiple client machines. A distributed DBMS, on the other hand, can span multiple geographically separate machines. In this case, the individual databases (i.e., SWCIS in Armenia, and NWCIS in Georgia and Azerbaijan, and/or databases of Hydromet and environmental agencies) are linked together by the Internet or WAN system.

For the water cadastre information systems in Armenia, Azerbaijan, and Georgia, a data warehouse system, which uses the relational model and client-server architecture, has been designed, constructed and tested. The data warehouse in each country contains data/information gathered from multiple organizations and stored under a unified, integrated database schema at a single site. Efforts are underway in each country to build new and improved national water cadastre Websites to share information. For example, the existing WRMA's Website in Armenia will be updated to provide water resources data/information (i.e., the Annual State Water Cadastre Report with 34 tables, water quality graphs, and maps from the Water Resources Atlas). As for Azerbaijan and Georgia, a new national Website will be constructed and deployed by the NWCIS host organization in each country. Using the similar information technologies for the NWCIS and Websites, several practical design options for the SCWIMS are devised and presented below.

SCWIMS Design Options

The first option is a broadly distributed information system that spans across all three countries via the Internet using the Websites of the NWCIS organizations as the building blocks for the SCWIMS. The Web-based SCWIMS will consist of two major components:

(a) Internet map services to provide dynamic water resources maps from an ArcGIS-based regional geodatabase and (b) pre-defined hyperlinks to about 30 organization Websites to show available water resources data and information from each organization. For the first component, on-line dynamic map services using ArcIMS to enable users to perform ad-hoc queries and generate customized maps will be used. The second component is similar to the "metadata portal" of the SCWP Website (<http://portal.scaucasuswater.org/>) with



specific URL links to the water resources organization Websites. With this design, the information will not be physically stored and managed by the SCWIMS. Instead, all information will be agency-based and not consolidated in any way by country or region.

The second option is a simpler distributed information system that spans across all three countries with fewer Website hyperlinks to maintain. The SCWIMS will use the three Websites of the NWCIS host organizations as the base for the SCWIMS. The system will provide: (a) on-line dynamic maps via the regional geodatabase, and (b) water resources data, summaries and statistics of each country via hyperlinks to the three NWCIS Websites (i.e., WRMA Website in Armenia and NWCIS Websites in Azerbaijan and Georgia). With the second option, the water data/information will be stored and managed by each NWCIS and summarized by each country.



The third option is a centralized information system with a data warehouse similar to the NWCIS. The data warehouse will consist of: (a) a robust Microsoft SQL Server-based relational database (tabular data/information), and (b) the regional geodatabase (thematic map layers). Data from the three NWCIS' are replicated, consolidated, stored and managed in the SCWIMS and can be queried by users on-line. In addition to showing

dynamic maps based on the user's needs, this system enables users to interactively access tabular data/information via water objects on the Internet maps by linking the tabular database to the thematic layers via ArcGIS. In this case, the system will provide: dynamic maps plus relevant information from the relational database via ArcIMS and water data/information for the region via the SQL Server. For examples of both, please visit <http://nhdgeo.usgs.gov/viewer.htm> and <http://waterdata.usgs.gov/nwis/> respectively.



The primary benefit of Option 3 (compared with Options 1 and 2) is: users will be able to perform on-line queries by water object (river, catchment, watershed, and basin), organization, district, country and region; and the thematic map layers and tabular data/information will be linked to provide additional ways for users to visualize the tabular data/information spatially. The system architecture difference is water data/information from each country will be physically replicated, consolidated, stored and managed by the SCWIMS.

4. DEVELOPMENT OF THE SOUTH CACUSUS WATER INFORMATION MANAGEMENT SYSTEM

Building on achievements of Task 2.1 over the past 24 months, the three design options for SCWIMS were presented and discussed with NWCIS stakeholder organizations in recent workshops. As a result of the workshops in Baku and Tbilisi in June, and in Yerevan in September, Option 2 was preferred by the stakeholders in all three countries. With regional politics, it is important for each country to retain data ownership, thus maximizing sustainability of the SCWIMS in the long-term. The system architecture of Option 2 will consist of a Website that provides water data/information from each cooperating country via hyperlinks to the NWCIS Websites, plus Internet map services to interactively generate and display thematic maps based on user's requests.

With this option, a centralized regional water resources database will not be deployed under the project. The SCWIMS will be based on the data holdings of the NWCIS in each country. The Web-based, map-driven, information management system linking the national water cadastre Websites will form the backbone of the regional-scale system. The national water cadastre host organizations will be solely responsible for keeping water data current in the data warehouses and sharing the data via the NWCIS Websites.

The regional geodatabase component under Option 2 is no different from Options 1 and 3; it will be built and deployed by the project. The spatial data holding will have features that can be displayed on maps (e.g., rivers, water bodies, catchments, basins, water monitoring stations, roads, and administrative boundaries); these data are normally associated with a GIS. Pertinent spatial attributes such as name, water object code, coordinates, area, and length will also be included. Building the regional geodatabase with full participation from all three countries will be a major part of Task 2.1 in Year 3

SCWIMS Geodatabase

Over the last few years, digital spatial data for the region have become available via donor-funded projects and organizations in and outside the region. In Year 2, the SCWP teams gathered, organized and stored the available spatial data in an ArcGIS-based geodatabase. The geodatabase structure is based on the E.U. Water Framework Directive and ArcHydro data model (Appendix A). Moreover, the spatial data files were uploaded to the SCWP Website and shares with the public. In Year 3, the Task 2.1 team will improve the geodatabase with additional thematic layers and use the ArcIMS to provide Internet map services via the SCWIMS. This will enable users to generate maps with any combination of the following thematic layers by village, district, country, region, catchment, watershed, and basin:

- Hydrography (i.e., rivers, water bodies, aquifer boundaries, hydro-technical structures, water monitoring points, water use extraction and discharge locations, and wastewater discharge points).
- Drainage layers (i.e., catchments, basins, and watersheds).
- Topographic features and Images (i.e., Satellite imagery (Landsat 7 ETM+), Contours, and DEM).
- Infrastructure features (i.e., settlements, towns, cities, roads, and railways).
- Administrative features (i.e., national borders, region and county boundaries, basin management units, and office locations).

All the spatial layers will cover the entire region with a standard map projection. To meet international standards, the layers in the regional geodatabase will be stored in GCS, WGS1984 or UTM, WGS84, Meter projections.

SCWIMS Tabular Database

In general, data are not freely shared in the region due to national interest and security. To avoid the current data restrictions under the ministries and organizations in each country, Option 2 without a centralized regional water database is indeed the best choice. In this case, the SCWIMS will only hyperlink to the three water cadastre websites to provide water information for each country. The actual data for each country will reside on their respective servers. Thus, the NWCIS hosts will retain ownership of data and rights. No water data/information from each country will be captured and stored on the SCWIMS.

Linking Tabular Water Data to a Geodatabase

For the NWCIS, the SCWP will assist the host organizations to: (1) georeference the tabular data so it can be displayed via their corresponding locations on the map (i.e., click a water use extraction location to show technical details of the permit), and (2) link the tabular data using the WOC identifiers. For example, users can retrieve all water user permits for a specific reach of a river and sum the total quantity of water use.

With ArcGIS, a tabular database table in MS-Access can be linked to the map layer's attribute table if both tables have a field (column) with common data such as gauging station ID, water use permit number, and water object ID; this will allow the user to display time series water quantity data by clicking on a gauging site.

To fully integrate the tabular data in the three NWCIS, local service providers have been contracted in Georgia and Azerbaijan to apply the regional water objects coding (WOC) system developed by USAID WMP and SCWP. All rivers and catchments in Armenia were coded with unique identifiers in 2006. All of the major water database records (i.e., Water Quality, Water Quantity, and WUA/WDP databases) in Armenia have been assigned with the appropriate water object identifiers using the GIS script prepared by SCWP.

SCWP will add the regional water object identifiers to the agency water databases in Georgia and Azerbaijan to harmonize the water resources data in the region in Year 3. Technically, the water data for the region can be easily consolidated and queried via the water object identifiers in a database management system such as MS-Access or MS-SQL Server and linked to the regional geodatabase. For the SCWIMS without a centralized regional water database under Option 2, it will be difficult to merge the water data between the three countries and the water data to the map objects via the three NWCIS Websites. Nevertheless, the water data in each NWCIS will be available via the SCWIMS for regional and international discussions and cooperation between Armenia, Azerbaijan, and Georgia on issues surrounding water management that is critical to the South Caucasus, but the water data/information will not be consolidated across country boundaries.

Efforts are underway to promote data sharing, collaboration, and reuse at all government levels in Armenia. In the near future, the three countries should review and upgrade the SCWIMS design to a centralized DBMS such as Option 3 to strengthen capacity for trans-boundary basin management.

5. PARTICIPATING ORGANIZATIONS

The stakeholder organizations for the SCWIMS development will include the three NWC hosts: WRMA in Armenia, NGES in Azerbaijan, and WRP in Georgia. A regional SCWIMS workshop with participants from all three countries will be conducted in January 2008 to discuss technical details, data sharing issues, and possible solutions. The specific topics of the workshop will be formulated later, but in general the SWCP proposes the following:

- Revisit the three options and present technical details about Option 2.
- Discuss and agree on the scope of data (tabular and spatial) to be shared through the SCWIMS.
- Identify and agree on the detailed data items to be shared between the three cooperating countries through the SCWIMS. Agree upon the frequency of SWCIS information updates.
- Discuss if it is necessary to sign a memorandum on regional information exchange by the ministries in all three countries under Option 2.
- Discuss and recommend a suitable organization to host the SCWIMS.

6. RECOMMENDED INFORMATION TECHNOLOGIES and DATA SHARING GUIDELINES

The SCWP, in consultation with the three water cadastre host organizations, is planning to construct the SCWIMS by the end of FY 2008. The primary information technologies recommended for the development of the SCWIMS are:

- Website technology to provide public access to water information on the SCWIMS Website.
- Internet technology to hyperlink to the three national water cadastre websites.
- ArcGIS (a geographic information system from Environmental System Research Institute, running on Window Server 2003) to develop and manage the regional geodatabase.
- ArcIMS (Internet map service software from Environmental System Research Institute, running on Window Server 2003) to author map services using the regional geodatabase, and serving maps and GIS applications through the SCWIMS Website.

The SCWP has procured the necessary hardware and software to support the development of the SCWIMS.

Additionally, specific guidelines for data management, coordination and sharing were prepared to enhance the Government's investment in water resources data and to facilitate data sharing and coordination in each of the three countries (Appendix B). The project is ready to build and deploy the SCWIMS with the three stakeholder organizations in FY 2008.

Appendix A. Spatial Data Organization

Purpose

The purpose of this document is to provide guidance for organization and documentation of spatial data for the South Caucasus Water Program.

Three areas are covered:

- (1) Identification of data layers/maps necessary for achieving the purposes of this project.
- (2) Organization and file structure for storing and using these data layers.
- (3) Documentation and Metadata requirements.

Recommendations for each of these three areas are based upon two sets of considerations. The first set are considerations related to achieving the purposes of this project; i.e., considerations related to sharing of information across national borders and addressing transboundary water resource issues. The second set of considerations relate to future use of the information and data created and used for this project. Such future considerations include use of such tools as ArcHydro for analysis and building more comprehensive information systems that include capabilities associated with river networks found in ArcGIS. A second set of considerations relate to developing a structure of such data in the three countries in a way that is compatible with requirements for such data within the EU Water Framework Directive.

Spatial Data Requirements

Requirements for what spatial data should be gathered, stored and used to achieve the purpose of this project are closely related to the spatial data requirements and data availability of three different organizations and models. In brief, these are: the spatial data needed to use ArcHydro for both analysis and for creating river networks that utilize the network analysis capabilities of ArcGIS; data required and used by the E.U.; and as a looser guide, data currently available for the U.S. from standard government agency sources. Using requirements for ArcHydro as well as the E.U. to guide selection and storage of spatial data will optimize the use of this data in the future and provide a tangible product from this project.

ArcHydro is a set of procedures, models, analyses, and data requirements that can be very useful for addressing questions regarding water quantity and quality issues within and across national boundaries – which is the purpose of this project. Providing the capability for use of the procedures, models and analyses from ArcHydro can enhance the capability of each country and for transboundary organizations to manage water resources within the countries of the South Caucasus. Included are tools for analyzing problems facing such management as well as developing river basin plans aimed at providing the goods and services needed and desired by the people within these countries while protecting water resources.

Also, in the future, being able to address water resources and water resource planning and management in ways compatible with the E.U. would appear a benefit. This is particularly true if any of the three countries applies for E.U. membership. But even if they do not apply or become E.U. members, being compatible with E.U. requirements will facilitate sharing of information across borders.

The following table identifies data/map layers identified as needed for ArcHydro, E.U. water resource GIS requirements/guidelines and data that is currently available for similar uses from the standard U.S. government agencies involved in this type of data. In the last column are the recommendations for data/map layers for the South Caucasus countries from this project.

LAYER/MAP/Other Info	ArcHydro	E.U.	USGS/NHD	South Caucasus
<i>RASTER</i>				
DEM	yes	yes	yes	yes
Satellite Imagery/Aerial Photos	yes	no	yes	yes
<i>VECTOR</i>				
Rivers	yes	yes	yes	yes
Water Bodies				
Lakes	yes	yes	yes	yes
Transitional Waters	yes	yes	yes	yes
Coastal Waters	yes	yes	yes	yes
Reservoirs	yes	yes	yes	yes
Swamps/wetlands	yes	yes	yes	yes
Aquifer Boundaries	no	yes	yes	yes
Monitoring Sites				
Quantity	yes	yes	no	yes
Quantity	yes	yes	no	yes
Extraction Points	yes	yes	no	yes
Discharge Points	yes	yes	no	yes
Protection Areas				
Drinking Water	yes	yes	yes	if available
Bird Protection Areas	no	yes	yes	if available
Habitat Protection Areas	no	yes	yes	if available
Recreation Waters	yes	yes	no	if available
Economically Significant Aquatic Species Areas	no	yes	no	if available
Nutrition Sensitive Areas	no	yes	no	if available
Political Boundaries	yes	yes	no	yes
Competent Authority	no	yes	no	yes
EcoRegion	no	yes	no	no
Hydrological-technical Structures (dams, diversion structures)	yes	no	no	yes

LAYER/MAP/Other Info	ArcHydro	E.U.	USGS/NHD	South Caucasus
Boundaries				
Catchment	yes	yes	no	yes
Watershed	yes	yes	yes	yes
Basin	yes	yes	yes	yes
Channel Features				
Cross-Section	yes	no	no	no
Cross-Section Point	yes	no	no	no
Profile Line	yes	no	no	no
Scale				
1:250000	yes	preferred	yes	yes
1:100000	yes	yes	yes	yes
1:24000 or 1:25000	preferred	no	preferred	preferred
Additional Capability				
Vegetative Cover	yes	no	no	yes
Hydrological Response Units	yes	no	no	when available
Optional Maps				
Settlements/Towns/Cities	no	no	yes	yes
Roads	no	no	yes	yes
Railroads	no	no	yes	yes
Utility Lines				
Electric	no	no	no	yes
Phone	no	no	no	yes
Water lines	no	no	yes	yes
Natural Gas lines	no	no	no	yes
Oil/Gasoline Pipelines	no	no	no	yes

Explanatory Comments for this table include:

- (1) Data layers/maps listed under “Additional Capability” are layers that are not strictly necessary for most of the features for ArcHydro. These are layers necessary for doing specific analyses such analysis of major storm events and possible flooding. These data layers/maps are of a lower priority than others listed above.
- (2) The E.U. includes a map/data layer representing “Competent Authority.” This may fit both Azerbaijan and Armenia where there are Basin Management Units and/or other field offices of involved agencies. It does not appear to be relevant for the current or anticipated situation in Georgia.
- (3) The E.U. includes a map/data layer representing “Protection Areas.” These may not be designated as such within the three countries of the Southern Caucasus. Such data would assist development of Basin Plans and in cases where it currently does not exist, could be gathered and delineated during the preparation of basin plans. For this reason, the recommendation in the table is to include such data when it is available and applicable.

- (4) A general recommendation is to not include EcoRegions as a data layer/map. Experience has shown that such delineations often add unnecessary complications and obscure factors critical to management and planning of land and water resources.

Spatial Data Organization

Spatial data comes in many different forms including geodatabases, shape files, rasters, MapInfo files, ERDAS format, and CAD based layers. Further, any spatial data can have one of hundreds of projections and coordinate systems. And these can all be stored in various ways on a computer. Having data in different formats and/or different projection/coordinate combinations as well as stored in different ways can complicate: (1) sharing data among the three countries; (2) building a regional spatial database for addressing transboundary questions; and (3) developing GIS applications that would benefit each of the three countries. A common method for organizing and storing data including using a common projection/coordinate system will facilitate accomplishing the goals of this project. The following sections provide a template for organization and storage of spatial data to be used in all three countries and at the Regional level.

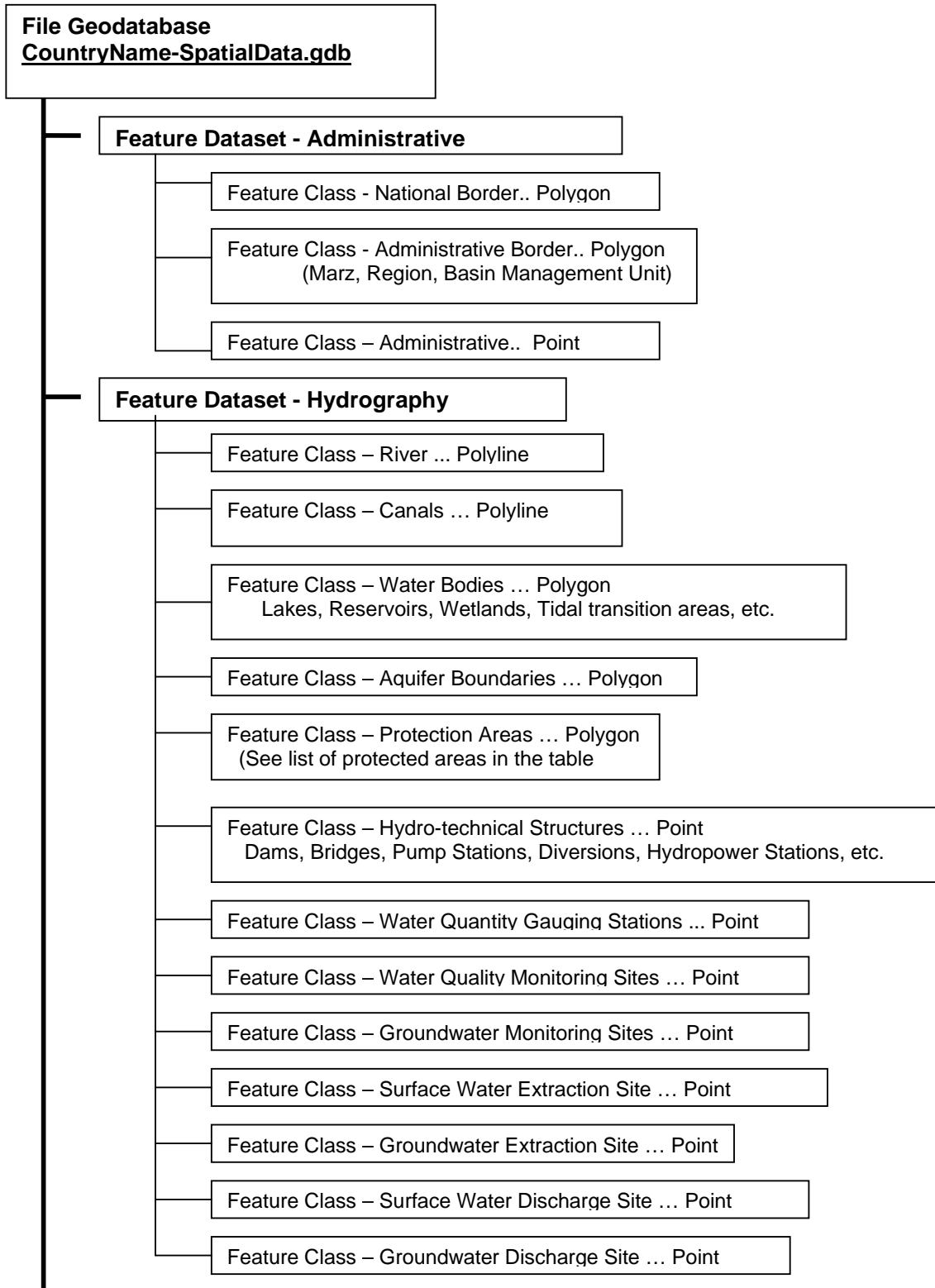
Data Storage All maps/data layers will be stored in a File Geodatabase (1TB per table) as defined in ArcGIS 9.2. (A File Geodatabase is one of the three kinds of Geodatabases that can be created and used in ArcGIS 9.2.) Note, projects started as a file geodatabase can easily be moved to any of the scale geodatabases such as MS-SQL Server, IBM DB2, Informix, and Oracle.

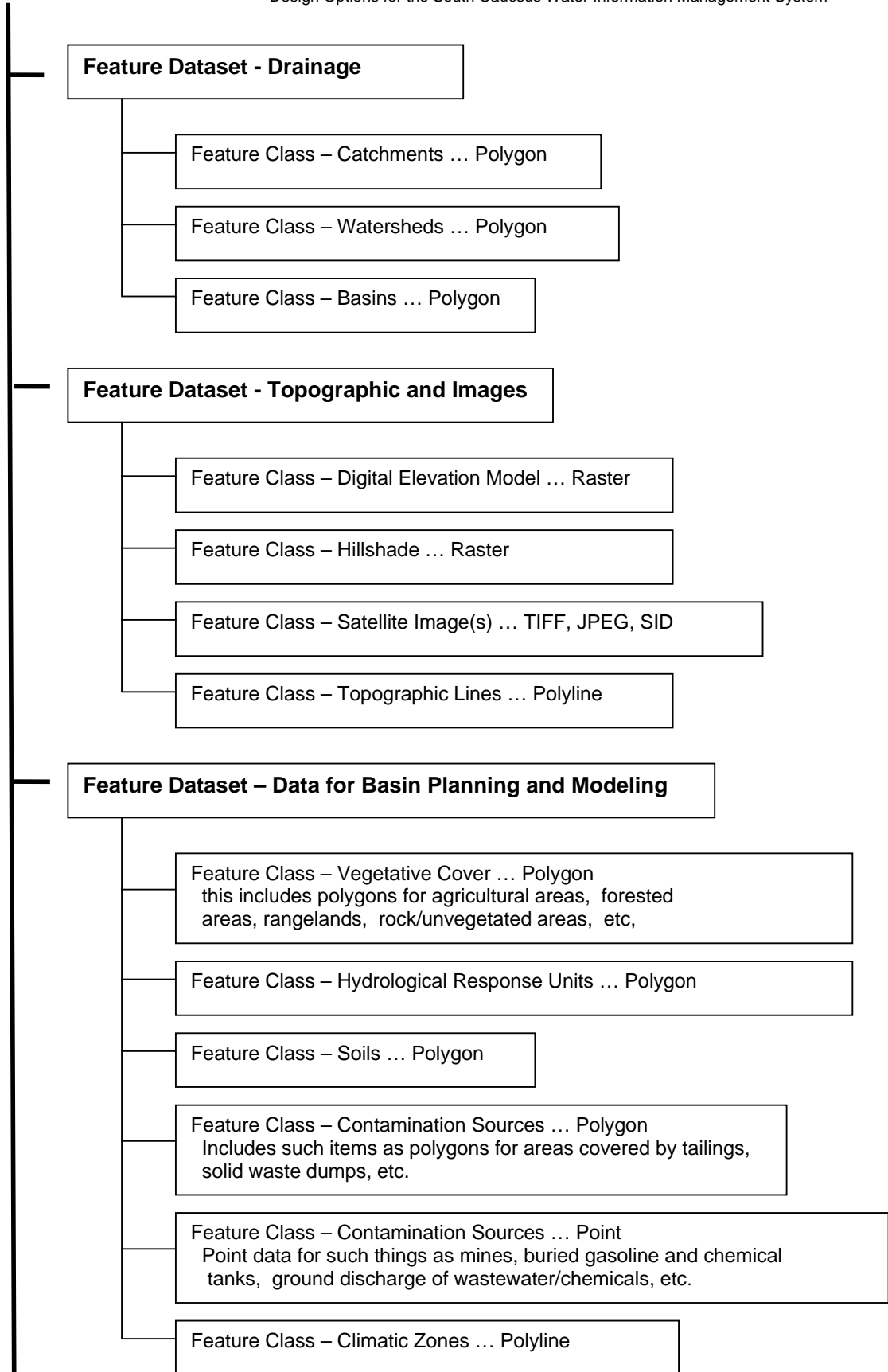
Coordinate System and Projection All maps/data layers within this File Geodatabase will use Geographic Coordinates (decimal degrees) and the WGS-1984 Projection (GCS-84).

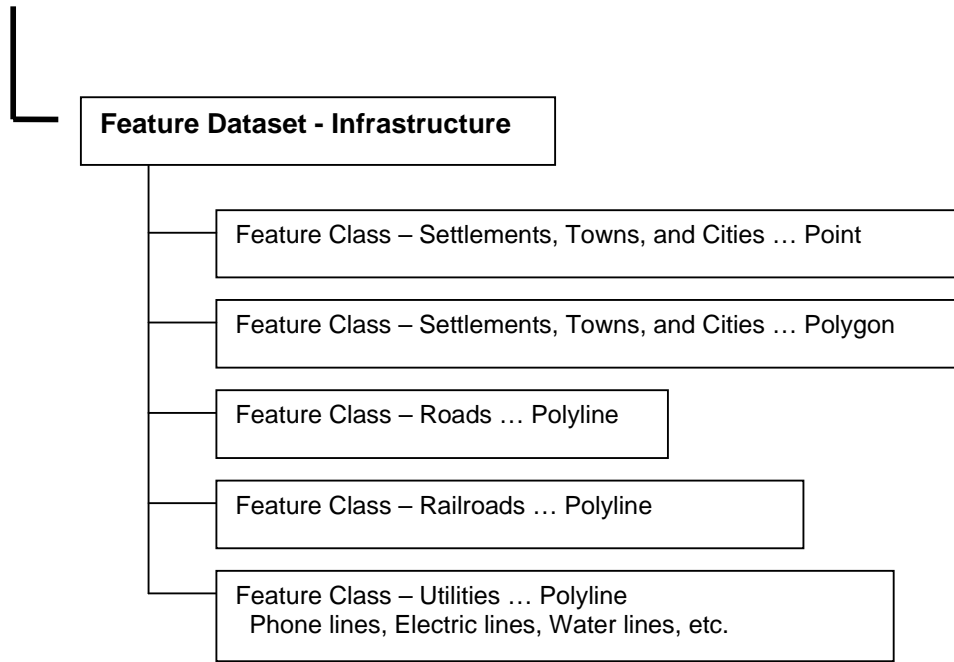
Countrywide Map Layers All maps/data layers within the File Geodatabase for each nation will be for the entire country. Once a national data layer is created, the maps/data layers used to create that can be copied to a CD or DVD and archived.

Data for Specific Areas There are existing maps/data layers that cover only a portion of a country (e.g., the pilot areas) or will be created during basin planning. This data can be organized in using the same File Geodatabase Structure as the national and regional data. In other words, in a country, there could be: one File Geodatabase for the national level with all layers covering the entire country; one File Geodatabase for each of the Pilot Watersheds; a fourth File Geodatabase (assuming two pilot areas) for an area covered in a special study such as the Coastal Study area in Georgia; and separate File Geodatabases for each River Basin Planning area. Each of these File Geodatabases would have exactly the same structure as outlined below.

Geodatabase Structure or Catalog All maps/data layers will be stored in a File Geodatabase that is organized using the following Catalog:







Metadata

Metadata is data about data. Metadata for spatial maps/data layers stored for use in GIS should provide information on those maps such as who created the maps, when, to what accuracy, and what is the extent of the map. Input and storage of metadata for those maps and tables stored for this project will be done by using the **Metadata Edit features of ArcCatalog**. The following metadata are the minimum necessary for each map:

I. Identification

- A. General - Abstract – A brief description of the map including the Country represented by the data (Georgia, Azerbaijan, Armenia), the map scale of the original data, and the organization/source of the data.
- B. General - Access Constraints – Who can access and download.
- C. General - Use Constraints – How the data can be used.
- D. General – Keywords –
 - 1. Theme keyword – for instance Rivers, Roads, Settlements
 - 2. Place – put in the Country – Azerbaijan, Armenia, Georgia.

II. Data Quality

- A. Source Information - General
 - 1. Source Scale Denominator – For a 1:25,000 map, the entry here would be 25,000.
 - 2. Type of Source Media – Paper, for example.
 - 3. Source Contribution – Who provided the original data?
- B. Source Information - Source Time Period of Content – fill in all data items to provide information of when it was that the original data was collected.

III. Contact

- A. Person or Organization
- B. Email contact

IV. Citation – Title of the map.

Automatic Items Filled in by ArcCatalog

I. Identification

- A. Bounding Coordinates – Extent of the Map

II. Data Organization

- A. Direct Spatial Reference Method – Vector, Raster or Point
- B. Feature Type
- C. Feature Count
- D. Spatial Index
- E. Linear Referencing
- F. Point and Vector Object Type

G. Point and Vector Object Count

III. Spatial Reference

A. Geographic Coordinate System Name

B. Projected Coordinate System Name

C. Horizontal Datum Name

D. Ellipsoid Name

E. Semi-Major Axis

F. Denominator of Flattening Ratio

G. Horizontal Coordinate System – all data items

H. Entity Attribute – base information on all of the attributes.

IV. Metadata Reference

Appendix B. Data Management, Coordination and Sharing Guidelines

Purpose

To enhance the Government's investment in water resources data and to facilitate data sharing and coordination in each of the three countries, the SCWP has prepared the following *Data Management and Sharing Guidelines*. These guidelines will be reviewed and adopted on behalf of the SWCIMS and NWCIS participating organizations and will present the preferred practices of the participating organizations in regard to data management, data sharing, and coordination.

Background

Accessing information related to water resources in the region should be seen as a critical unmet need for many of the organizations working to manage their precious water resources. The SCWP have identified access to information as a gap and a primary focus point to improving water resources information management by: (1) deploying a water resources metadata and information portal under the SCWP Website, (2) developing a *National Water Resources Information System* for each country, and (3) constructing a web-based *South Caucasus Water Information Management System*.

The goal of these three products is to provide ways to improve data management, coordination, and sharing information using modern IT solutions.

The portal includes a searchable catalog with links to datasets and their associated metadata. If a dataset is not available for download or on-line viewing, then contact information is provided. This catalog currently includes spatial and tabular datasets, mapping applications, and reports.

Three national water cadastre information systems will provide water resources and use information to the participating organizations via each Ministry's Intranet and/or VPN.

SCWIMS will be deployed in 2008 and will provide available water resources information for Armenia, Azerbaijan, and Georgia via the Internet. The water resources metadata and information portal will be modified and incorporated as a part of the information system.

Data Management, Coordination and Sharing Principles

The SCWP has proposed the following principles related to data coordination, management, and sharing

- (1) To the extent possible and necessary, the participating organizations will alter their internal policies, contracts, and databases that affect water resources data to comply with these guidelines.
- (2) All SCWIMS and NWCIS partners will receive these "*Guidelines*" describing data exchange guidelines and metadata content and format instructions. Training and technical support will be provided by the SCWP as partners are encouraged to meet these guidelines.
- (3) Before creating a new dataset, staff from the participating organizations shall search the NWCIS and SCWIMS to see if the data already exists and work to coordinate, not duplicate.
- (4) The SWCP will work on developing standard keywords to help NWCIS and SCWIMS users locate information relevant to their search using the portal.
- (5) The SWCP will work with the NWCIS participating organizations to design win-win data coordination and sharing programs.

- (6) The SWCP will communicate, educate, and promote these guidelines and act as a liaison with the NWCIS organizations.

Data Exchange Format Guidelines

Data guidelines facilitate efficient data integration and information sharing. Access to and analysis of information, along with collaboration between organizations, will be greatly improved by using standard formats for data exchange and metadata. Organizations use an array of software tools to manage their data. Data collectors need the flexibility to decide how to store and maintain their data to meet their internal business needs. However, standardizing the formats for data exchange will benefit everyone involved in coordinated water resources management. All data providers are encouraged to support the following guidelines.

Participating organizations will use one or more of the following data export formats for their data.

- (1) Spatial data: SHP (vector ESRI shapefiles), DXF (AutoCAD export), DWG (AutoCAD), E00 (ArcInfo export), ERSI grid, TIFF (Raster), SID (Mr SID Raster).
- (2) Tabular data: MDB (MS Access), XLS (MS Excel), DBF (Dbase), CSV or common delimited ASCII.
- (3) Text (including metadata): DOC (MS Word), PDF (Adobe), RTF (Rich Text Format), ASCII, HTML.
- (4) Graphics: JPG, GIF, TIF, PNG.
- (5) Compressed data: ZIP, TAR, SID (Raster).

Data Licensing Guidelines

Without a data licensing agreement and method of acknowledging the terms of the license, unnecessary barriers to data access is created. SCWP recognizes that it will take time to work out the legal and procedural issues but in the interim recommends the following:

- (1) Participating organizations will adopt an online data agreement process rather than requiring signed paper agreements. This will facilitate the distribution and exchange of data over the Internet.
- (2) Participating organizations should consider that all datasets posted online are free for download and use by everyone.

Data Access Guidelines

Participating organizations agree to make their data available for discovery and access through the NWCIS, SCWIMS, and the portal by one or more of the following methods:

- (1) Metadata and data posted to NWCIS and SCWIMS.
- (2) Metadata posted on the SCWP Website with data access through an embedded link in the metadata.
- (3) Metadata posted on the SCWP Website with instructions on how data can be accessed.

Spatial Data Standards

Determining and referencing location is the fundamental value of spatial information such as the location of a specific water object. Spatial data built on common technical standards of registration (datum) and reference (coordinate system) provides the foundation for integration and reuse of the Government's investment in spatial data.

- (1) Datum: WGS 84 (World Geodetic System 1984).
- (2) Coordinate System: GCS or UTM (Universal Transverse Mercator) grid.

Metadata

Metadata, at a minimum, should always include the following basic elements:

- (1) Title of the dataset.
- (2) Brief description of the dataset content and purpose.
- (3) Spatial reference, datum, and coordinate system.
- (4) Contact name, phone number, email address, position, and organization.
- (5) Beginning and ending date of content.
- (6) Theme and place keyword.
- (7) Data collection methods.
- (8) Use constraints.

Two metadata reports are provided below for use by all the participating organizations.

Tabular Data

Summary Report:

Title			
Steward Agency:		Last Update Year:	
Administrating Agency:			
Country:			
Countrywide Data:			
Data File Format(s):			
Categories:			
Description:			

Detailed Report:

Title:			
Description:			
Scale:		Metadata Level:	
Update Frequency:		Dataset Date Range:	

Last Update Year:			Last Update Date:		
Steward Agency:					
Administrating Agency:					
Country:					
Dataset URL:					
Fee Charged:					
Countrywide Coverage:					
Specific Location:					
Data Distribution List:					
User		Format/Method		Frequency	
Data Attributes:					
Categories:					
Data Types:					
Transfer File Formats:					
View Options:					
Location Keywords:					
Theme Keywords:					

For metadata for spatial data, please refer to Appendix A for details.

Additional Data Operational Guidelines

- (1) The WOC identifier as assigned in each country should be included in the dataset for data sharing.
- (2) Users need to be aware of scale differences when integrating spatial data, and be knowledgeable about interpreting the results. 1:25,000 scale topographic maps are used by SCWP.
- (3) SCWP will develop and promote the use of migration tools to automate synchronization of data from each organization to NWCIS and SCWIMS in the future.