Report for 2002RI1B: Hydrologic Relational Database for Rhode Island

There are no reported publications resulting from this project.

Hydrologic Relational Database for Rhode Island

Anne I. Veeger, Nasir Hamidzada
Dept. of Geosciences
University of Rhode Island

Prashanth Galisukumar, Udayan Dutta
Dept. of Computer Science
University of Rhode Island

Abstract

The ability to store, retrieve and analyze hydrologic data is a key component of efficient planning and environmental management. In Rhode Island, existing hydrologic data are stored in a variety of U.S. Geological Survey, RI DEM, RI Department of Health, and individual investigator files and databases. Data collected through RI Water Resources (RIWRC) Center funded research for example, is stored in paper format in the form of a final report. This limits the potential application and usefulness of the data to State and local agencies and other investigators. A multi-dimensional relational database management system (GeoInfoDB), which permits storage and retrieval of hydrologic data for sampling sites, addresses the need for unified and accessible data storage. The database incorporates both spatial and non-spatial data by using a GIS approach. The spatial data are stored in an ArcInfo Coverage and the non-spatial data are stored in Access. Querying, display and analysis of data (including site location, field data, laboratory data) is possible, thereby creating the capacity to complete spatial analysis of the data in a geographic information system (GIS). This database can be used by future investigators to submit hydrologic data in electronic format as part of their reporting procedure. This will ensure continued population of the relational database with up-to-date hydrologic information. The resulting Rhode Island hydrologic data coverages are compatible with existing RIGIS coverages and are an important planning and assessment tool for the State.

Introduction

The ability to store, retrieve and analyze hydrologic data is a key component of efficient planning and environmental management. In Rhode Island, existing hydrologic data are stored in a variety of U.S. Geological Survey, RI DEM, RI Department of Health, and individual investigator files and databases. Data collected through RI Water Resources (RIWRC) Center funded research for example, is stored in paper format in the form of a final report. This limits the potential application and usefulness of the data to State and local agencies and other investigators.

Clearly, there is a need to develop a unified database to improve storage of and access to the hydrologic data generated through the funding activities of the RIWRC.

This need is addressed through the development of a multi-dimensional relational database management system (GeoInfoDB), which permits storage and retrieval of complete hydrologic data for sampling sites. This relational database uses Access for data storage and ArcView for data access and analysis. Querying, display and analysis of data (including site location, field data, laboratory data) are possible, thereby creating the capacity to complete spatial analysis of the data in a geographic information system (GIS). This database can be used by future investigators to submit hydrologic data in electronic format as part of their reporting procedure. This will ensure continued population of the relational database with up-to-date hydrologic information. This database can also be expandable to include data from ongoing monitoring projects such as the URI Watershed Watch Program.

The resulting Rhode Island hydrologic data coverages are compatible with existing RIGIS coverages and will be an important planning and assessment tool for the State. This database will also provide the RIWRC with an information technology and outreach tool.

Nature, scope, and objectives of the project

This project contributed to the development of a relational database called GeoInfo (in Microsoft Access) capable of storing hydrologic data from surface-water and ground-water sites. Relational databases are powerful tools for data storage because they permit the development of complex and multi-dimensional relations between data elements. When linked with the capacities of a geographic information system (GIS) the database becomes a powerful tool for not only storing, retrieving and displaying data, but also spatial and temporal analysis.

The objectives of this project were as follows:

- Development of database structure. This represents the synthesis of data components into a framework for the database. Through meetings with interested parties we will establish the types and range of data to be included in the database. A site database template will serve as the main data table that will link to associated data tables (field data, laboratory data, well data, geologic/soil data, interpretation, etc).
- Construction of relational database.
- Population of the relational database with data from projects in the Pawcatuck Watershed and from Jamestown RI.
  Produce digital maps that display the location of all database sites on a variety of map

bases (topographic, digital orthophoto, cultural). These maps and the associated database will be compatible with the State's GIS system (i.e. RIGIS).

Introduction to GeoInfoDB

GeoInfoDB is a relational database developed at the Department Of Geosciences, University Of Rhode Island. It is designed to handle a wide varieties of hydrologic, geological and geotechnical data. Currently it stores data related to three data types, water quality, wells/boreholes, and soil-gas radon.

The database is designed to be scalable which allows addition of new data types or removal of existing data types from the database. All data information pertaining to individual data type exists in a modular structure aiding in ease of flow of data within the database. Spatial and Thematic data can be incorporated within the database and can be linked to GIS software's and Rock ware database without any difficulty paving way for advanced analysis of the data. The database has been normalized to reduce redundancy. Multilevel referential integrity has been maintained throughout the database, which ensures data consistency.

GeoInfoDB incorporates essential elements of each date type. For water quality sites this includes site information (location, site type, altitude) and both field and laboratory water quality parameters including major and minor inorganic constituents, stable and radioactive isotopes as well as nutrients and trace metals. For well or borehole sites, data include land-surface elevation; depth to water table; depth to bedrock; and interval data on selected material properties, including low and/or high blow count zones, organic soils, and artificial fill. The complete subsurface record of the borehole lithology can also be recorded. Radon data related to soil gas and indoor radon can include radon related chemistry.

The existing data can be viewed and modified at any point of time. Data retrieval can be performed using several existing queries based on criteria's such as location (county, city, quad, X and Y coordinates), project names, depth to bedrock, depth to water, hole depth, company names (Funding Agency, Engineering company, Geotechnical Company, Drilling Company). Data for the multiple entries like lithology, fill, organic material and Blow count are retrieved using existing queries. Scanned log sheets if present for existing borehole data can be viewed in bitmap format.

This database can be applied to store information about the water quality, subsurface geology, and radon data for any region in Rhode Island. GeoInfoDB is one part of a larger project, designed to develop an interactive, web-based, and GIS-oriented library of geological data in Rhode Island. The GeoInfoDB project is jointly funded by the Rhode Island Water Resources Center (water quality module) and the University of Rhode Island Transportation Center and Rhode Island Department of Transportation (subsurface geology module) and the URI Department of Geosciences (radon module).

DATABASE STRUCTURE AND CHARACTERISTICS

GeoInfoDB design addresses the following goals: layer-by-layer (multi-value for a single field) data capacity, incorporation of legacy data, data import capability, and scalability to include diverse data as well as future database expansion. This is accomplished through a tiered structure with related tables for each category and type of data (figure 1). At present the database design includes three different types of data: borehole, water quality and

soil-gas radon. The data type associated with each record determines the data fields that will be populated. Each point location may be associated with multiple records and data types. The resulting modular database is therefore scalable, allowing future development and incorporation of additional data modules. The relational database will reside in a SQL server. Data access and querying, as well as display and analysis, can be accomplished through GIS applications (ArcView, ArcInfo). This will permit querying and display of water quality data, and access to all borehole related information.

System Requirements

Hardware Requirements

GeoInfoDB is a relational database that runs on Windows environment with the following minimum requirements

Windows PC
- Intel Pentium II or compatible
- 128 MB of available RAM
- 400 MB of hard disk space

Software Requirements

- Windows 2000 Professional or XP Professional or Home Edition
- Microsoft Access 2000 or XP
- ArcView 3.2 or later

Figure 1. Model relational database architecture for GeoINfoDB.