Introduction

INTRODUCTION

The Ground Water Atlas of the United States provides a summary of the most important information available for each principal aquifer, or rock unit that will yield usable quantities of water to wells, throughout the 50 States, Puerto Rico, and the U.S. Virgin Islands. The Atlas is an outgrowth of the Regional Aquifer-System Analysis (RASA) program of the U.S. Geological Survey (USGS), a program that investigated 24 of the most important aquifers and aquifer systems of the Nation and one in the Caribbean Islands (**fig. 1**). The objectives of the RASA program were to define the geologic and hydrologic frameworks of each aquifer system, to assess the geochemistry of the water in the system, to characterize the ground-water flow system, and to describe the effects of development on the flow system. Although the RASA studies did not cover the entire Nation, they compiled much of the data needed to make the National assessments of ground-water resources presented in the Ground Water Atlas of the United States. The Atlas, however, describes the location, extent, and geologic and hydrologic characteristics of all the important aquifers in the United States, including those not studied by the RASA program.

The Atlas is written so that it can be understood by readers who are not hydrologists. Simple language is used to explain technical terms. The principles that control the presence, movement, and chemical quality of ground water in different climatic, topographic, and geologic settings are clearly illustrated. The Atlas is, therefore, useful as a teaching tool for introductory courses in hydrology or hydrogeology at the college level and as an overview of ground-water conditions for consultants who need information about an individual aquifer. It also serves as an introduction to regional and National ground-water resources for lawmakers, personnel of local, State, or Federal agencies, or anyone who needs to understand ground-water occurrence, movement, and quality.

The purpose of the Ground Water Atlas of the United States is to summarize, in one publication with a common format, the most important ground-water information that has been collected over many years by the USGS, other Federal agencies, and State and local water management agencies. The purpose of this introductory chapter is to describe the content of the Atlas; to discuss the characteristics, use, and limitations of the maps and other types of illustrations used in the different chapters of the book; to summarize the locations of the principal aquifers on a Nationwide map; and to give an example of an aquifer in each principal hydrogeologic setting.

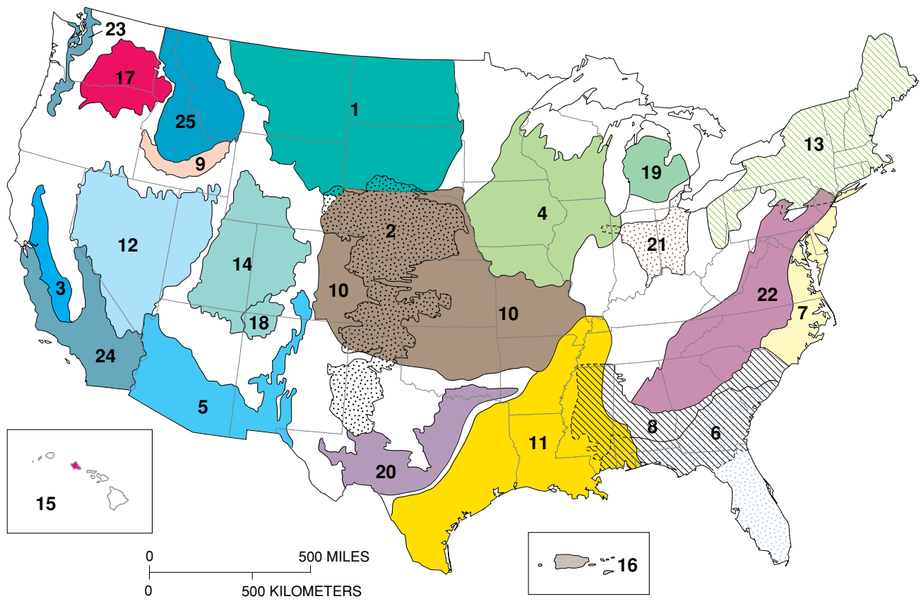

Figure 1. *The Regional Aquifer-System Analysis program of the USGS studied 24 of the most important aquifers and aquifer systems in the United States, and one in the Caribbean Islands.*

Modified from Sun and Johnston, 1994

EXPLANATION

Regional aquifer system study areas

1	Northern Great Plains
2	High Plains
3	Central Valley, California
4	Northern Midwest
5	Southwest alluvial basins
6	Floridan
7	Northern Atlantic Coastal Plain
8	Southeastern Coastal Plain
9	Snake River Plain
10	Central Midwest
11	Gulf Costal Plain
12	Great Basin
13	Northeast glacial aquifers
14	Upper Colorado River Basin
15	Oahu, Hawaii
16	Caribbean Islands
17	Columbia Plateau
18	San Juan Basin
19	Michigan Basin
20	Edwards–Trinity
21	Midwestern basins and arches
22	Appalachian valleys and Piedmont
23	Puget–Willamette Lowland
24	Southern California alluvial basins
25	Northern Rocky Mountain Intermontane Basins

Figure 2. *The Ground Water Atlas of the United States consists of an introductory chapter and descriptive chapters that discuss the principal aquifers in 13 multi-State segments.*

EXPLANATION

Hydrologic Atlas Chapter	Content	Segment number
730–A	Introductory material and nationwide summary	—
730–B	California, Nevada	1
730–C	Arizona, Colorado, New Mexico, Utah	2
730–D	Kansas, Missouri, Nebraska	3
730–E	Oklahoma, Texas	4
730–F	Arkansas, Louisiana, Mississippi	5
730–G	Alabama, Florida, Georgia, South Carolina	6
730–H	Idaho, Oregon, Washington	7
730–I	Montana, North Dakota, South Dakota, Wyoming	8
730–J	Iowa, Michigan, Minnesota, Wisconsin	9
730–K	Illinois, Indiana, Kentucky, Ohio, Tennessee	10
730–L	Delaware, Maryland, New Jersey, North Carolina, Pennsylvania, Virginia, West Virginia	11
730–M	Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, Vermont	12
730–N	Alaska, Hawaii, Puerto Rico, U.S. Virgin Islands	13

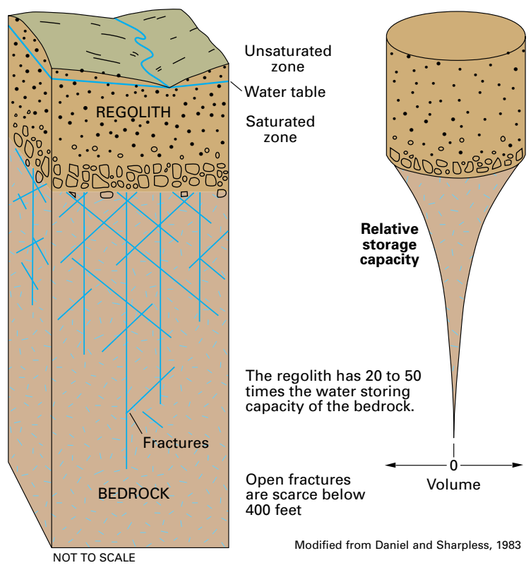

Figure 3. *Diagrams that illustrate principles of ground-water occurrence and movement, such as this illustration from Atlas Chapter G, can be readily photographed or converted into overhead transparencies for use as teaching aids.*

Modified from Daniel and Sharpless, 1983

ATLAS DESIGN

The Atlas consists of 14 chapters; this introductory chapter and 13 descriptive chapters which show the principal aquifers in regional areas called Segments that collectively cover the 50 States, Puerto Rico, and the U.S. Virgin Islands (**fig. 2**). The regional areas were delineated using two criteria: to keep each area at a size within which detail about each principal aquifer could be shown at a reasonable, uniform map scale; and to contain the most important regional aquifers or aquifer systems entirely within an area. Neither minor aquifers nor the minor features of the geology and hydrology of major aquifers are illustrated or described in the Atlas because of the scale of the maps. The 13 descriptive chapters have been published separately as Hydrologic Investigations Atlases 730–B through 730–N (**fig. 2**) and may be purchased by mail from the U. S. Geological Survey, Information Services, Box 25286, Federal Center, Denver CO 80225.

Maps are the primary types of illustrations in each Atlas chapter, but are supplemented by cross sections, block diagrams, charts, graphs, and photographs as needed to describe the geology and hydrology of each principal aquifer. Large-scale maps are necessary to describe some aquifers, such as the Biscayne aquifer of southeastern Florida (Atlas Chapter G) that extends over only a three-county area, but is the source of water for millions of people. In contrast, small-scale maps are needed for aquifers that extend over large areas, such as the High Plains aquifer that covers parts of eight States and four Atlas segments in the central part of the Nation. A set of five uniform map scales has been chosen so that the maps can be directly compared within a chapter and among different chapters.

Most of the illustrations in the Atlas use color to emphasize the information and to increase the clarity and understandability of the complex data or interpretive material that is presented. To help maintain consistency, each principal aquifer is assigned a unique color that is used to map the aquifer wherever it appears in the Atlas. Expanded, simplified figure captions describe the principal features of each illustration. Extensive reference lists are included in each chapter to assist readers who may require additional information. Photographs are frequently used to show special geologic or hydrologic conditions, or the results of aquifer development.

Each of the 13 descriptive chapters begins with an overview of climatic, geologic, and hydrologic conditions throughout the regional area covered by the chapter. The overview contains maps that show precipitation, runoff, physiography, geology, and ground-water withdrawals from each county in the regional area. The position and relation of each aquifer with respect to overlying, underlying, and laterally adjacent aquifers is shown by block diagrams and cross sections. The largest, and perhaps most important, illustration in each chapter is a map showing the shallowest principal aquifer throughout the regional area. Some chapters describe areas in the north-central and northeastern parts of the Nation, where productive surficial aquifers in glacial deposits of sand and gravel overlie bedrock aquifers. In these chapters, the surficial aquifers and the bedrock aquifers are shown on separate regional maps. Where aquifers are stacked atop other aquifers, the order of discussion is from shallowest to deepest.

A variety of illustrations is used to describe each principal aquifer in each regional area. Maps are used to show the location and extent of the aquifer, the thickness of the aquifer, the potentiometric surface of the aquifer (a surface that represents the level to which water will rise in wells completed in the aquifer), and the general chemical quality of the water that the aquifer contains. Where data are available, maps are used to show changes in aquifer water levels or the chemical quality of the water in the aquifer over time. Correlation charts list the geologic formations or parts of them that compose the aquifer, and show subdivisions that might exist in complex, layered aquifers or aquifer systems. Hydrogeologic sections show the relation of the aquifer to the geology of the area. Arrows are superimposed on the hydrogeologic sections and on the potentiometric-surface maps to show the direction of movement of water in the aquifer. Hydrographs are used to show the rise and fall of aquifer water levels in response to changes in the amount of precipitation or the rate of ground-water withdrawal. Pie diagrams are used to show the amount of water that is pumped for different uses or to illustrate the percentage of chemical constituents in the water. Special conditions caused by human activities are discussed and described; such conditions include land subsidence over large areas or sinkhole development caused by excessive ground-water withdrawals, waterlogging or salt buildup in the soil caused by extensive irrigation, and large water-level declines or saltwater intrusion caused by excessive pumping of ground water.

No new data were collected for the Atlas because the large amount of ground-water data available in the reports and files of the USGS and other agencies was sufficient for its preparation. Published illustrations and interpretations were merged, combined, modified, and simplified where necessary. The interpretive results and data bases of the RASA program were major sources of information for compilation of the Atlas. Where necessary, the results of some of the RASA studies were combined, or the RASA regional syntheses were supplemented by the results of smaller-scale studies. Maps and other types of illustrations were prepared from existing data for some aquifers for which no appropriate published illustrations were available.

Regional maps of the aquifers in most Atlas chapters show large to small areas that are designated either “minor aquifers,” “not a principal aquifer,” or “confining unit.” Such areas are underlain either by low-permeability deposits and rocks, unsaturated materials, or aquifers that supply little water because they are of local extent, poorly permeable, or both. Permeability is the relative ease with which water will move through a rock unit; aquifers are more permeable than confining units. Within the areas mapped as principal aquifers, existing data are not uniformly distributed in space and time, because hydrologic investigations mostly have been conducted in areas where water supply or water quality problems existed, or where large quantities of ground water were withdrawn. Except for widely scattered places, long-term hydrologic records are rare because data is usually collected only during the course of a study or perhaps for a few years after the study has ended.

USE OF THE GROUND WATER ATLAS

The Atlas is designed to give an overview of the most important aspects of the geology, hydrology, ground-water flow system, general water quality, and use of the water withdrawn from the Nation’s principal aquifers. The Atlas does not present a comprehensive description of all that is known about each principal aquifer or aquifer system. Because many of the aquifers and aquifer systems described extend over large areas, small-scale maps are required to show conditions throughout the entire aquifer. Accordingly, illustrations in the Atlas should not be used for local information or site-specific interpretations. The listed references should be consulted for detailed information about each principal aquifer or aquifer system.

Many Atlas chapters contain diagrams that illustrate basic concepts concerning the occurrence and movement of ground water. For example, some areas are underlain by fractured crystalline rock on which regolith, a combination of soil and weathered rock, has developed (**fig. 3**). The storage capacity of the regolith, which is characterized by intergranular porosity, or pore space between individual grains, is many times greater than that of the underlying crystalline rock, which is porous only where fractured. The cylinder-and-cone diagram on the right of **figure 3** summarizes the relative storage capacity of the physical situation shown on the left of the figure. Overhead transparencies or slide photographs can easily be made from such illustrations for classroom use in introductory hydrogeology courses.

The Atlas summarizes ground-water investigations that have been made over many years by a large number of hydrologists. It is, thus, a reference work that can be used by planners, consultants, teachers, and present and future hydrologists. It can also be consulted by hydrologists in other countries who wish to learn about the ground-water hydrology of the United States.

The Atlas accurately shows the principal aquifers of the United States and summarizes the significant characteristics of their flow systems and water quality. However, the scales of most of the maps used do not permit the descriptive chapters to be used to locate future water supplies, predict areas where overdrafting (withdrawals in excess of natural recharge), saltwater encroachment, or contamination are likely to occur, and so on. Studies such as these require maps and reports of much greater detail. Nevertheless, the Atlas shows significant features of the regional geology, permeability, and ground-water movement of the principal aquifers. Maps in the Atlas can also be used in conjunction with geologic and other types of maps for regional or national planning activities.