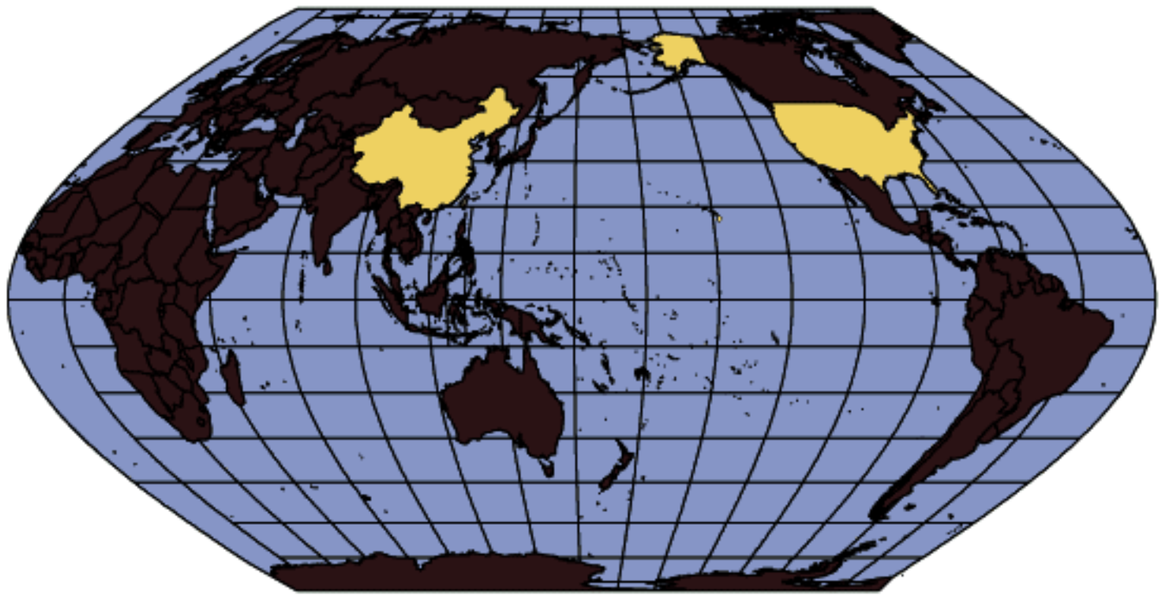

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Professional Paper 1647

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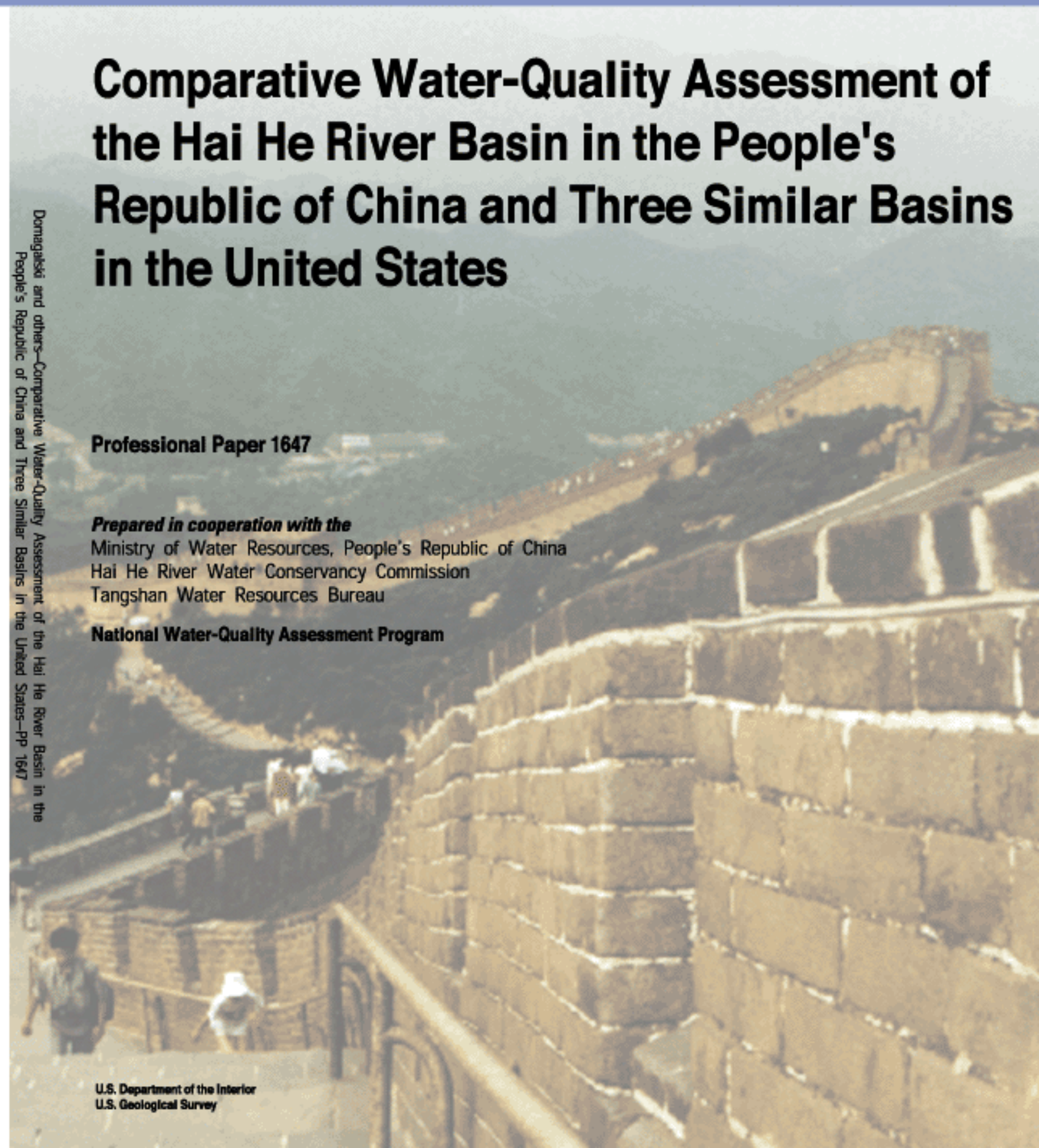

U.S. Department of the Interior
U.S. Geological Survey

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By Joseph Domagalski[1], Zhou Xinquan[2], Lin Chao[2], Zhi Deguo[2], Fan Lan Chi[2], Xu Kaitai[3], Lü Ying[3], Luo Yang[2], Liu Shide[3], Liu Dewen[2], Guo Yong[2], Tian Qi[4], Liu Jing[2], Yu Weidong[5], Robert Shedlock[6], *and* Donna Knifong[1]

U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 1647

NATIONAL WATER-QUALITY ASSESSMENT PROGRAM

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FOREWORD

The U.S. Geological Survey (USGS) is committed to serve the Nation with accurate and timely scientific information that helps enhance and protect the overall quality of life, and facilitates effective management of water, biological, energy, and mineral resources. Information on the quality of the Nation's water resources is of critical interest to the USGS because it is so integrally linked to the long-term availability of water that is clean and safe for drinking and recreation and that is suitable for industry, irrigation, and habitat for fish and wildlife. Escalating population growth and increasing demands for the multiple water uses make water availability, now measured in terms of quantity and quality, even more critical to the long-term sustainability of our communities and ecosystems.

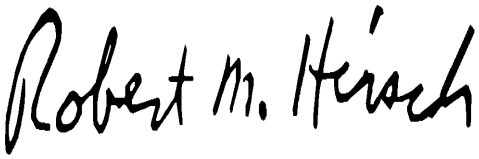
The USGS implemented the National Water-Quality Assessment (NAWQA) Program to support national, regional, and local information needs and decisions related to water-quality management and policy. Shaped by and coordinated with ongoing efforts of other Federal, State, and local agencies, the NAWQA Program is designed to answer: What is the condition of our Nation's streams and ground water? How are the conditions changing over time? How do natural features and human activities affect the quality of streams and ground water, and where are those effects most pronounced? By combining information on water chemistry, physical characteristics, stream habitat, and aquatic life, the NAWQA Program aims to provide science-based insights for current and emerging water issues. NAWQA results can contribute to informed decisions that result in practical and effective water-resource management and strategies that protect and restore water quality.

Since 1991, the NAWQA Program has implemented interdisciplinary assessments in more than 50 of the Nation's most important river basins and aquifers, referred to as Study Units. Collectively, these Study Units account for more than 60 percent of the overall water use and population served by public water supply, and are representative of the Nation's major hydrologic landscapes, priority ecological resources, and agricultural, urban, and natural sources of contamination.

Each assessment is guided by a nationally consistent study design and methods of sampling and analysis. The assessments thereby build local knowledge about water-quality issues and trends in a particular stream or aquifer while providing an understanding of how and why water quality varies regionally and nationally. The consistent, multi-scale approach helps to determine if certain types of water-quality issues are isolated or pervasive, and allows direct comparisons of how human activities and natural processes affect water quality and ecological health in the Nation's diverse geographic and environmental settings. Comprehensive assessments on pesticides, nutrients, volatile organic compounds, trace metals, and aquatic ecology are developed at the national scale through comparative analysis of the Study-Unit findings.

The USGS places high value on the communication and dissemination of credible, timely, and relevant science so that the most recent and available knowledge about water resources can be applied in management and policy decisions. We hope this NAWQA publication will provide you the needed insights and information to meet your needs, and thereby foster increased awareness and involvement in the protection and restoration of our Nation's waters.

The NAWQA Program recognizes that a national assessment by a single program cannot address all water-resource issues of interest. External coordination at all levels is critical for a fully integrated understanding of watersheds and for cost-effective management, regulation, and conservation of our Nation's water resources. The Program, therefore, depends extensively on the advice, cooperation, and information from other Federal, State, interstate, Tribal, and local agencies, non-government organizations, industry, academia, and other stakeholder groups. The assistance and suggestions of all are greatly appreciated.



Robert M. Hirsch
Associate Director for Water

Editor's Note

This report is based on a research study in the People's Republic of China. The report was edited for an international technical audience and for Chinese readers with English as a second language (ESL). For example, the term "Tangshan study area" is used prior to defining "Tangshan study unit," which is used thereinafter to denote the specific Tangshan area under study. The term "physiographic provinces" was changed to "physiographic regions" to prevent possible miscommunication with the Chinese geographic term "Provinces." Other similar assessments were made during the language editing phase of the editorial process.

The style used for site names and well locations in the area studied outside the United States—the Tangshan region of the People's Republic of China—was taken from unpublished data and from correspondence with the Chinese coauthors. The "Atlas of the People's Republic of China," produced and published in the People's Republic of China (see the "Xiudong" listing in the References Cited section at end of this report), was used to verify spellings of Chinese cities, rivers, and other geographic features. Style editing included appropriate use of syntax of Chinese phrases, diacritical marks, and syllable boundary markers (for example, "the two-syllable "Xi'an" for two Chinese characters is distinguished from the single syllable "xian" for a single Chinese character). In some places in the report, "People's Republic of China" was respectfully replaced with "China" to reduce repetition or because of limited space such as in table cells; the United States of America is referred to in shortened fashion as well.

Some USGS standards for style of illustrations have been customized as well. In the bar graph figures—figures 30, 31, 32, and 33—the Legend, or Explanation box, does not include the word "Explanation." This word was eliminated to maintain consistency with the boxes of similar figures in which "Explanation" is not required when the box appears within the illustration, as with figures 21–25 and 34–36. In the "Piper diagrams" (figures 13–20), the term "trilinear graph" replaces the term "Piper diagram." Some slight variation in graphical elements on maps of areas in the People's Republic of China and the United States is the result of different digital sources.

The References Cited section includes no references pertaining to Chinese data on the study because, though available, this information has not been published in the international scientific literature. Representatives from various water agencies in the People's Republic of China (Hai He River Water Conservancy Commission, Tangshan Water Resources Bureau, and the Chinese Ministry of Water Resources) have worked extensively with the U.S. Geological Survey on the content of this report. This collaboration is noted in the authorship on the title page.

CONTENTS

FIGURES

TABLES

Multiply	By	To obtain
cubic meter (m^3)	0.0008107	acre-foot
kilogram (kg)	2.205	pound avoirdupois
kilometer (km)	0.6214	mile
megagram (Mg)	1.102	ton (2,000 lb)
megagram per square kilometer (Mg/km^2)	2.855	ton (2,000 lb) per square mile
meter (m)	1.094	yard
milligram per liter (mg/L)	8.345	pound per million gallon
millimeter (mm)	0.03937	inch
square hectometer (hm^2)	2.471	acre
square kilometer (km^2)	0.3861	square mile

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F = (1.8)°C + 32$$

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (μS/cm at 25°C).

Concentrations of chemical constituents in water are given in either milligrams per liter (mg/L) or micrograms per liter (μg/L).

1 megagram = 1 metric ton = 1 tonne = 1,000 kilogram

Abbreviations and Acronyms

μg/L, microgram per liter
μm, micrometer
μS/cm, microsiemens per centimeter
pCi/L, picocurie per liter

CFC, chlorofluorocarbon
DBCP, 1,2-dibromo-3-chloropropane
δ, delta
EPA, U.S. Environmental Protection Agency
GIS, Geographic Information System
H, hydrogen
^2H, deuterium
^3H, tritium
^3He, helium-3
N, nitrogen
NAWQA, National Water-Quality Assessment (Program)
O, oxygen
p, level of statistical significance
per mill, parts per thousand
PRC, People's Republic of China
RASA, Regional Aquifer Systems Analysis
ρ, Spearman's rho
U.S., United States
USGS, U.S. Geological Survey
yr, year

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