QUALITY-ASSURANCE PLAN FOR WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN IDAHO

By F.A. Packard

U.S. GEOLOGICAL SURVEY

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QUALITY-ASSURANCE PLAN FOR WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN IDAHO

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Abstract

To ensure continued confidence in its products, the Water Resources Division of the U.S. Geological Survey implemented a policy that all its scientific work be performed in accordance with a centrally managed quality-assurance program. This report establishes and documents a formal policy for current (1995) quality assurance within the Idaho District of the U.S. Geological Survey. Quality assurance is formalized by describing district organization and operational responsibilities, documenting the district quality-assurance policies, and describing district functions.

The district conducts its work through offices in Boise, Idaho Falls, Twin Falls, Sandpoint, and at the Idaho National Engineering Laboratory. Data-collection programs and interpretive studies are conducted by two operating units, and operational and technical assistance is provided by three support units: (1) Administrative Services advisors provide guidance on various personnel issues and budget functions, (2) computer and reports advisors provide guidance in their fields, and (3) discipline specialists provide technical advice and assistance to the district and to chiefs of various projects.

The district's quality-assurance plan is based on an overall policy that provides a framework for defining the precision and accuracy of collected data. The plan is supported by a series of quality-assurance policy statements that describe responsibilities for specific operations in the district's program. The operations are program planning; project planning; project implementation; review and remediation; data collection; equipment calibration and maintenance; data processing and storage; data analysis, synthesis, and interpretation; report preparation and processing; and training. Activities of the district are systematically conducted under a hierarchy of supervision and management that is designed to ensure conformance with Water Resources Division goals on quality assurance.

The district quality-assurance plan does not describe detailed technical activities that are commonly termed "quality-control procedures." Instead, it focuses on current policies, operations, and responsibilities that are implemented at the management level. Contents of the plan will be reviewed annually and updated as programs and operations change.

INTRODUCTION

As the Nation's principal earth-science information agency, the U.S. Geological Survey (USGS) has developed a worldwide reputation for collecting accurate data and producing factual and impartial interpretive reports. Methodologies for data collection and analysis developed by the USGS have become standard techniques that are used by Federal, State, and local agencies and private enterprises. The stringent standards of professional conduct, meticulous attention to detail, and thorough review that characterize the routine activities of the USGS have given users a sense of confidence and trust in the accuracy and scientific validity of USGS products. As competition for the Nation's finite water supply has intensified, programs to manage, protect, develop, and regulate the resource have become subjects of increasingly contentious debate. As a result, the products of USGS data collection and investigative programs are increas-

ingly scrutinized, and the users of USGS products are now expecting and, in some instances requiring, that USGS programs be conducted in a manner that provides continuing measures of the precision and accuracy of results.

In response to those expectations, the Water Resources Division (WRD) has implemented a program designed to ensure that all scientific work performed by or for the division is conducted in accordance with a centrally managed quality-assurance program. The responsibility for the program has been assigned to the Office of the Assistant Chief Hydrologist for Technical Support. That office has established the Branch of Technical Development and Quality Systems to develop, coordinate, and implement the quality-assurance program. As a part of that program, each district in the WRD is required to prepare a written quality-assurance plan covering all elements of scientific work conducted by that district. As part of this plan, the national and regional organizational structure shown in figure 1 defines some of the management structure used to carry out quality assurance. Figure 1 diagrammatically shows that the quality-assurance review functions by headquarters and regional staff are independent of line operations in the districts that generate and process data. Practices that are found by anyone in the organization to be inconsistent with established quality-control procedures are reported, corrected, and documented among reviewers and line managers.

Mission and Programs

The USGS was established by an act of Congress on March 3, 1879, to provide a permanent Federal agency staff to conduct a systematic and scientific "classification of the public lands, and examination of the geological structure, mineral resources, and products of national domain." An integral part of that original mission includes publishing and disseminating the earth-science information needed to understand, manage, and develop the Nation's energy, land, mineral, and water resources.

The mission of the WRD is to provide the hydrologic information and understanding needed for the optimum utilization and management of the Nation's water resources for the overall benefit of its people. This mission is accomplished, in large part, through cooperation with other Federal and non-Federal agencies, by:

- Collecting, in a systematic way, data needed for the continuing determination and evaluation of the quantity, quality, and use of the Nation's water resources.
- Conducting analytical and interpretive water-resource appraisals describing the occurrence, availability, and physical, chemical, and biological characteristics of surface and ground water.
- Conducting supportive basic and problem-oriented research in hydraulics, hydrology, and related fields to improve the scientific basis for investigations and measurement techniques and to understand hydrologic systems sufficiently well to quantitatively predict their response to natural or anthropogenic stress.
- Disseminating water data and the results of investigations and research through reports, maps, computerized information services, and other forms of public releases.
- Coordinating the activities of Federal agencies in the acquisition of water data for streams, lakes, reservoirs, estuaries, and ground water.
- Providing scientific and technical assistance in hydrologic fields to other Federal, State, and local agencies; to licensees of the Federal Energy Regulatory Commission; and to international agencies on behalf of the U.S. Department of State.
- Acquiring, developing, and disseminating information on water-related natural hazards such as droughts, floods, landslides, land subsidence, mudflows, and volcanic eruptions.
- Administering the provisions of the Water Resources Research Act of 1984, which includes the State Water Resources Research Institutes and the Research Grants and Contracts programs.
- Supporting the provisions of the National Environmental Policy Act of 1969 and managing USGS natural-resource surveys in response to the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund Act) of 1980 and its amendments.

The WRD has collected and disseminated information about the quality and quantity of water in streams, lakes, and aquifers for more than a century. In Idaho, through cooperative and collaborative programs with local, State, and other Federal agencies, the Idaho District has monitored streamflow at hundreds of sites throughout the State and has investigated the occurrence, availability, and quality of water in numerous study areas. Information obtained from

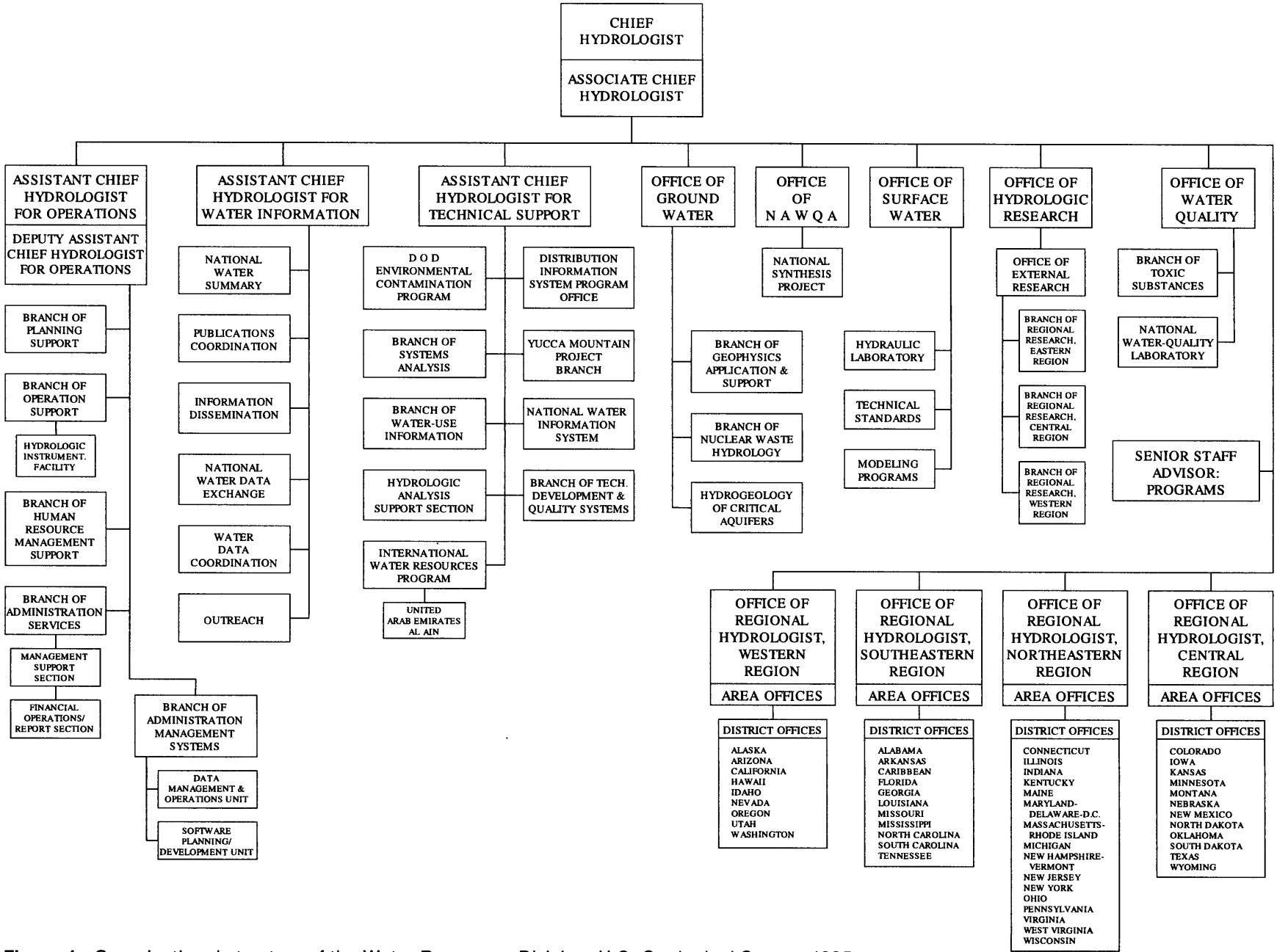

Figure 1. Organizational structure of the Water Resources Division, U.S. Geological Survey, 1995.

data-collection programs, investigative studies, and research efforts has been made available to the public, water-resource managers, regulating agencies, and developers through published formal reports, such as annual data reports and reports of interpretive studies, and through informal means, such as release of tabular hydrologic data and presentations at public meetings.

Purpose and Scope

This report establishes and documents a formal policy for the conduct of quality assurance within the Idaho District of the USGS. Quality assurance is formalized by:

- Describing the district organization and operational responsibilities.
- Describing the district functions and the quality-assurance responsibilities for performing those functions.
- Documenting the district quality-assurance policies.

Responsibility for the quality-assurance plan rests ultimately with the District Chief; however, the responsibility for implementation of various aspects of the plan is shared within the district. For instance, much of the ground-water and water-quality data collection is performed by project personnel in interpretive studies; in these instances, the responsibility lies mostly with the project chief, the section chief, and the discipline specialists. It is imperative that all individuals in the district be committed to participating in this plan to achieve quality-assurance goals.

This report describes current (1995) district policies, operations, and responsibilities implemented at the management level and outlines a set of procedures to ensure that the district quality-control system is conforming to established procedures. These policies and responsibilities are presented as they relate to operational elements of the district's hydrologic programs and apply to work performed by district or contract personnel. This report does not describe detailed technical procedures that commonly are termed "quality-control procedures," activities that are carried out to produce a quality product. Such activities are documented in the district quality-control system, which is described in unpublished district quality-control plans, referenced literature, workplans, district and WRD memorandums, and field manuals.

Contents of this report will be reviewed annually by the District Chief or a designee. As programs and functions change, the policy will be revised.

DISTRICT ORGANIZATION AND OPERATIONAL RESPONSIBILITIES

The Idaho District conducts its hydrologic work through the district office in Boise, the Idaho National Engineering Laboratory (INEL) project office in Idaho Falls, and field offices in Boise, Idaho Falls, Twin Falls, and Sandpoint (fig. 2). In 1995, the district employed 101 people (87 full time and 14 part time) to work on about 25 funded projects. The principal mission of the district is to investigate the occurrence, quantity, quality, distribution, and movement of surface and ground water in Idaho.

Interpretive studies and hydrologic data-collection programs in Idaho are conducted by several operating units—INEL, National Water-Quality Assessment (NAWQA) Program, several other smaller projects, and the Data Collection and Management Section). Operational and technical assistance is provided by three support units (Administrative Services, Computer Services and Scientific Publications Section, and discipline specialists). The operating or line units are responsible for implementing and executing district projects. Administrative Services provides advice on personnel and budget matters to the office of the District Chief and the operating units. Computer and reports advisors provide guidance in their respective fields. Discipline specialists provide technical expertise to management and staff.

Operating Units

The major operating units (fig. 3) that participate in the quality-assurance program are defined in the following sections, along with a statement of each unit's purpose or function, and a definition of the staff positions responsible for the quality of the unit's products or tasks.

INVESTIGATIONS AND RESEARCH

The Assistant District Chief for Investigations and Research is responsible for planning, conducting, and

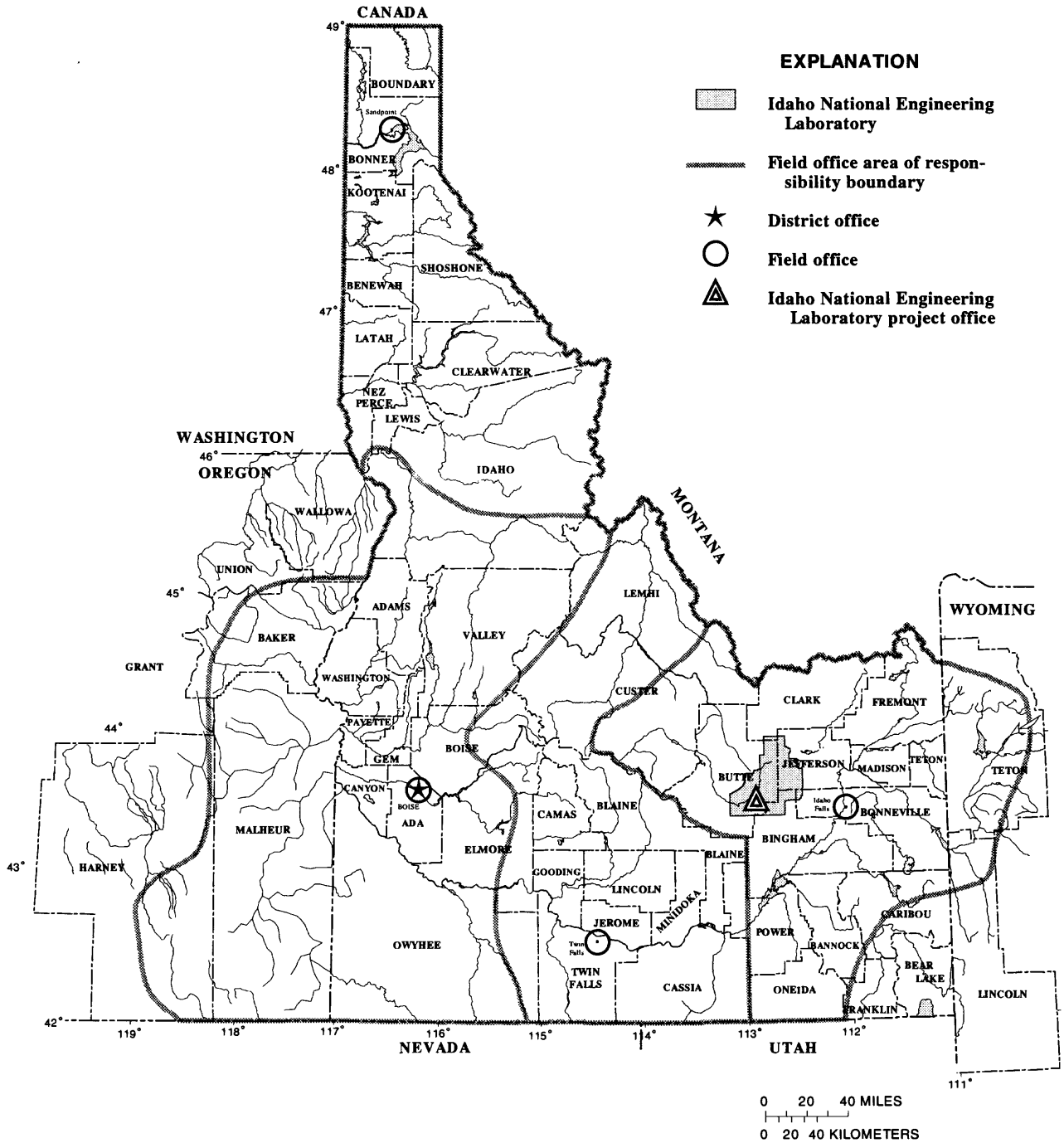

Figure 2. Location of district and field offices of the U.S. Geological Survey in Idaho and general areas of responsibility, 1995.

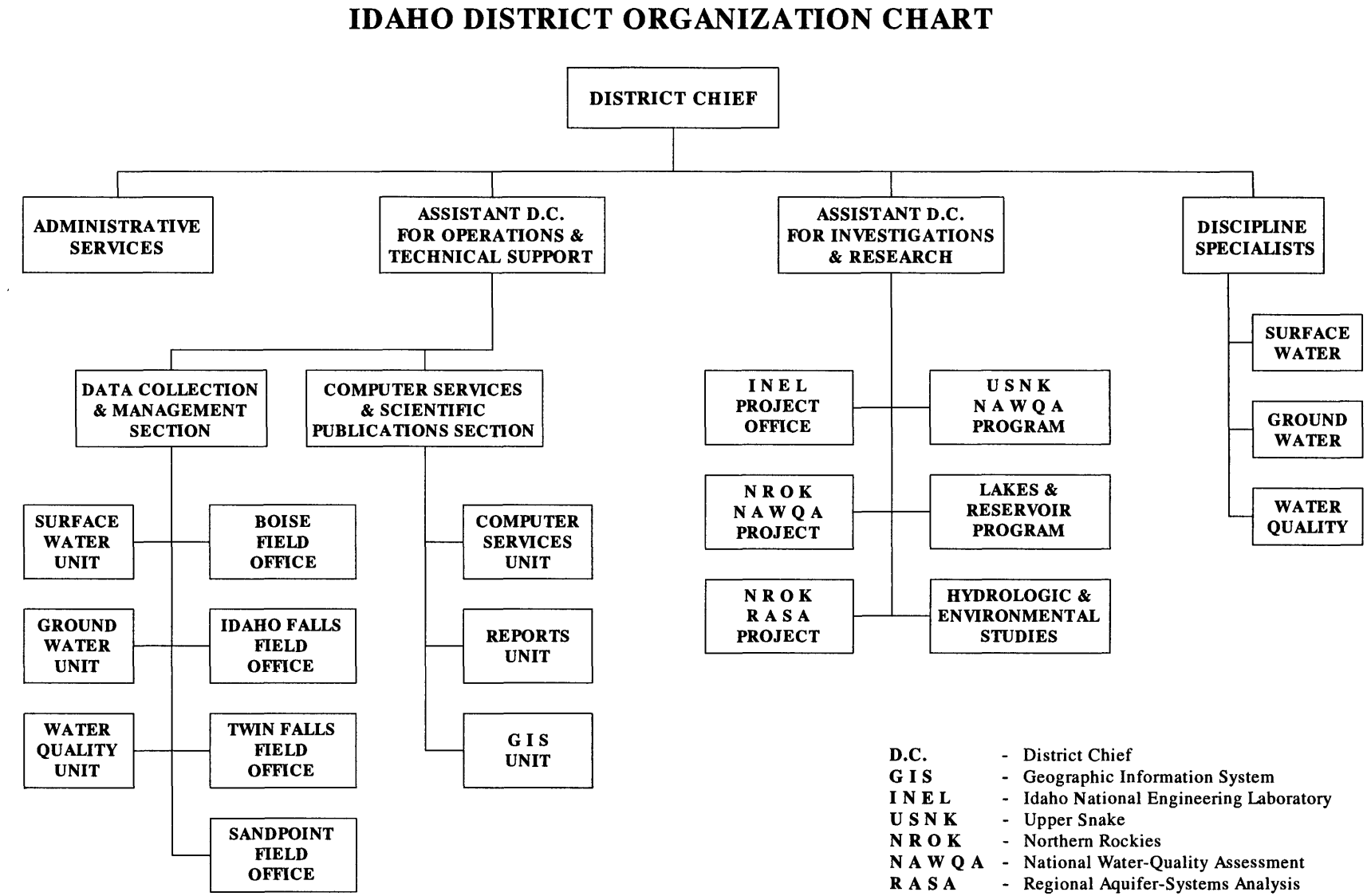

Figure 3. Organizational structure of the Idaho District, 1995.

reporting on multidiscipline water-resource projects. These investigations involve hydraulics and mathematical modeling of surface- and ground-water systems, lake studies, hydraulic effects of anthropogenic structures, magnitude and frequency of floods and droughts, assessment of surface-water availability and water use, and assessment or estimation of natural or anthropogenic effects on the quality of water in hydrologic systems.

Quality assurance of Investigations and Research work is governed by district policies relating to project planning, project implementation, data collection, data analysis and interpretation, project review and remediation, data synthesis, report preparation and processing, and training. The Assistant District Chief for Investigations and Research monitors all phases of project activities to ensure compliance with specific policies, and the district discipline specialists monitor work to ensure compliance with pertinent quality-control procedures.

Investigations and Research is composed of hydrologists and technical support personnel. Geohydrologists and geochemists conduct studies related to ground water and water quality and prepare reports for publication. Hydrologists, engineers, and geographers conduct studies related to surface-water hydraulics, hydrology, and water use. Aquifer tests conducted by district personnel are reviewed and approved by the district ground-water specialist before results are used in studies or published in reports. The water-use project chief is responsible for maintaining the State water-use data base. Responsibilities overlap within many interdisciplinary projects such as INEL and NAWQA.

Idaho National Engineering Laboratory (INEL) project

The INEL project is responsible for conducting studies to describe and evaluate the effects of radioactive and chemical waste disposal on the ground-water resources of the INEL area and, ultimately, on the regional aquifer and its discharge to wells and to the Snake River. INEL project responsibilities include describing present distribution patterns of waste products in the ground-water system and comparing current conditions with past conditions. Responsibilities also include evaluation of radiochemical, geochemical, and hydraulic processes that could affect aquifer water quality, and of the unsaturated zone underlying solid-waste burial ground to determine the possibility of downward solute movement toward the regional aquifer. INEL work is conducted under rigorous quality-control procedures. For this reason, INEL writes many of its own quality-assurance plans. The INEL project chief is responsible for compliance with quality-assurance policies.

National Water-Quality Assessment (NAWQA) Program

The NAWQA Program is responsible for conducting studies to describe current water-quality conditions in the ground- and surface-water systems of basins in the State and the relation of those conditions to sediment and agricultural chemicals and to the environmental effects of activities such as fish farming, food processing, cattle grazing, and mining. Water-quality issues are identified through coordination with other water agencies, and a retrospective analysis of surface- and ground-water quality is prepared. An investigation then is conducted to obtain a better spatial description of water quality and a better understanding of the correlation between study-unit characteristics and water quality. NAWQA project chiefs are responsible for compliance with quality-assurance policies defined by the district and by national NAWQA protocols.

Other programs

Additional programs or studies are carried out within Investigations and Research, but they are less extensive and (or) of a shorter term nature than the INEL project or NAWQA Program and, thus, are not specifically described here. These other programs traditionally comprise quantitative studies of ground-water and surface-water flow and storage in conjunction with measurements of associated water quality and its relation to natural conditions and human activities. Project chiefs, with the assistance of discipline specialists, are responsible for writing any special quality-assurance/quality-control (QA/QC) procedures for new projects as requested by the Assistant District Chief for Investigations and Research. Project chiefs are responsible for complying with quality-assurance policies and for achieving the goals defined in their respective project proposals. Results from these studies are used by scientists in reference to related scien-

tific investigations and by water-resource managers to evaluate water-use plans.

OPERATIONS AND TECHNICAL SUPPORT—DATA COLLECTION AND MANAGEMENT SECTION

The Data Collection and Management Section includes the surface-water, ground-water, and water-quality data units. This section is responsible for designing, constructing, operating, and maintaining the hydrologic-data networks in the State. It also is responsible for analyzing, reviewing, and processing data from these State networks, and preparing water-resources data for the annual water-data report. The four field offices within the section (Boise, Twin Falls, Idaho Falls, and Sandpoint) are responsible for data collection in their assigned areas, and each office is managed by a field office chief. The Assistant District Chief for Operations and Technical Support in Boise, the discipline specialists, the data-unit chiefs, and the field office chiefs are responsible for quality assurance of data collected, processed, published, and stored by the section. However, the initial responsibility for the quality assurance and control of data collection is delegated to each field person.

The three data units are responsible for compiling and maintaining information on peak flows and basin characteristics and for collecting and storing water-use data. The data units are also responsible for maintaining central files (surface water, ground water, and water quality) of data collected in the district; reviewing streamflow, ground-water, and water-quality records; and preparing data for publication in the annual water-data report. All surface-water data collected by district personnel as part of ongoing projects or statewide networks are entered into the Automated Data Processing System (ADAPS) data base. The district ADAPS data-base administrator (Surface Water Unit chief) is responsible for maintaining the ADAPS data base. The district surface-water specialist is responsible for reviewing and approving indirect streamflow measurements performed by personnel in the field offices.

Information from all wells inventoried by district personnel as part of ongoing projects or statewide networks is entered into the Ground-Water Site Inventory (GWSI) data base. The district GWSI data-base administrator (Ground Water Unit chief) is responsible for maintaining the GWSI data base.

The Water Quality Unit is responsible for planning, overseeing, and reviewing the collection and entry of water-quality data from monitoring stations in the district. The water-quality monitoring programs include collection of chemical and physical data from wells, streams, lakes, aquifers, and reservoirs. The district water-quality specialist provides quality-assurance oversight for calibration and maintenance of field instruments, maintenance of mobile field laboratories, collection of samples, preparation of field and laboratory forms, training of contract observers, and office review of field analyses.

Water-quality data collected by district personnel as part of ongoing projects or statewide networks are entered into the Water Quality Data Processing System (QWDATA) data base. The district QWDATA data-base administrator (Water Quality Unit chief) is responsible for maintaining the QWDATA data base.

The Water Quality Unit is also responsible for operating the district water-quality laboratory. Personnel assigned to the laboratory routinely measure water-quality characteristics, including suspended-sediment concentrations, and other constituents. The laboratory serves as the supply center for field and project offices for water-quality monitoring equipment, instruments, and supplies. Laboratory personnel prepare and distribute standard solutions and reagents for quality control and calibration checks of field instruments. The district water-quality specialist performs quality-control checks of water-quality equipment and instruments before they are distributed to field personnel.

Support Units

ADMINISTRATIVE SERVICES

Administrative Services provides administrative support to the district office and project chiefs. Support services include administrative activities related to personnel, purchasing, contracting, space, vehicles, and fiscal accounting. Although Administrative Services does not have direct quality-assurance responsibilities for technical aspects of the district program, the role in managing project budgets; purchasing equipment and supplies; contracting for services; securing office, shop, and storage space; acquiring vehicles; and other administrative duties is essential to the successful completion of the projects. The district administrative officer is responsible for monitoring

project and district budgets weekly and, on a monthly basis, advising project chiefs and district managers of the fiscal status of projects.

COMPUTER SERVICES AND SCIENTIFIC PUBLICATIONS SECTION

The Computer Services Unit is responsible for providing computer support to the district and to project chiefs. Personnel assigned to the unit operate and maintain the district microcomputer, workstation, and peripheral hardware. The unit provides technical support for the district's library of computer software, trains staff on use and application of various software packages, writes programs for various applications, and documents software developed for district use. Although the unit does not have direct quality-assurance responsibilities for technical aspects of the district program, its role in providing computer services is essential to the successful implementation and completion of district programs. The unit is responsible for periodic archiving of district computer files and records to ensure minimal loss of information in the event of equipment failure or malfunction. The computer specialist is responsible for efficient operation and effective use of the district's computer hardware and software.

The Reports Unit is responsible for providing report preparation and processing services for the district. Personnel assigned to the Reports Unit prepare text and illustrations from authors' rough drafts and perform editorial reviews and manuscript verification. The unit transmits reports for Director's or regional approval, prepares approved reports for publication, and distributes published reports. The unit is involved in early phases of project planning and implementation, and personnel assist project chiefs in planning final report products, preparing report outlines, and acquiring base maps for final products. Timely completion of well-written, technically sound reports is a direct measure of the district's success in meeting quality-assurance guidelines. Consequently, the Reports Unit serves an essential and integral role in the district's quality-assurance and -control efforts.

The GIS Unit is responsible for leading geographic information systems (GIS) activities in the district. As such, the unit provides complete GIS services or advises GIS users to follow established protocol for integrating these activities within the context of the district program and division, bureau, department, and executive policy. Personnel in the unit disseminate approved digital data to the public; acquire, manage, and archive digital data for various uses by personnel throughout the district; prepare working illustrations using GIS techniques; and transfer GIS themes to personnel in the Reports Unit where report illustrations are finalized. Products from the GIS Unit are often an intermediate step in a larger, multifaceted project. The unit works closely with personnel in other district sections and units to provide products on schedule so the overall project can be completed in a timely manner.

DISCIPLINE SPECIALISTS

Three discipline specialists serve as technical advisors to the office of the District Chief. Each discipline specialist has other primary duties; however, each contributes significantly to quality-assurance activities by virtue of his or her special competencies in particular fields. The discipline specialists, individually and collectively, assist in program planning, project planning, design and implementation of data-collection programs, technical oversight of interpretive projects, and review of reports.

The specialists each possess extensive technical competence in surface-water, ground-water, or water-quality disciplines. The specialists are responsible for technical adequacy of programs in their particular field of expertise. Project workplans and draft reports are reviewed by the discipline specialists to ensure technical adequacy of methodology, appropriate application of methodologies, and validity of results and conclusions. A list of other individuals within WRD with expertise in specialized fields of hydrology is available to project personnel, if needed, to supplement the experience of the discipline specialists.

QUALITY ASSURANCE

District Quality-Assurance Policy

Maintaining the credibility and technical excellence of USGS products is as much a function of attitude as adherence to written policy. An ethic of professionalism to conduct activities in a scientific, impartial, thorough, and meticulous manner will usually yield credible and valid results that are acceptable to most users and that can be used as the basis for liti-

gation or negotiations. In some instances, data or interpretive products might need to meet documented quality-control standards before being admissible in court proceedings. To meet this need, hydrologic work performed by or for the Idaho District is designed to satisfy the district quality-assurance policy.

Quality-assurance policy: "The Idaho District conducts all investigations in a manner that results in data of known quality, following the policies and technical directives of the U.S. Geological Survey, Water Resources Division."

The quality of data is considered to be "known" when a USGS approved and documented procedure is used to collect, process, or analyze the data. If work is performed for which no approved or documented procedure is applicable or available, adequate documentation is prepared to describe the precision, bias, and accuracy expected from the procedure used.

This quality-assurance policy does not always require use of the most accurate or precise methodology available. The methodology selected for a particular activity, however, is commensurate with the needs of the program, with consideration given to any constraints of funding, resources, and time available. The essential element is the requirement to define the precision, bias, and accuracy of the final product.

District Operations and Quality-Assurance Responsibilities

The activities of the Idaho District are conducted systematically under a hierarchy of supervision and management that is designed to ensure conformance with WRD policy on quality assurance. The systematic approach guides the direction of work from program planning to ultimate completion of assignments. Activities undertaken by the district are expected to meet the quality-assurance requirements outlined in this report for the following operations: program planning; project planning; project implementation; project review and remediation; data collection; equipment calibration and maintenance; data processing and storage; data analysis, synthesis, and interpretation; report preparation and processing; and training. Not all activities include every operation, but all conform to the quality-assurance policies that are appropriate to successful completion of the activity.

PROGRAM PLANNING

Quality-assurance policy: "Program plans are developed in accordance with the annual statement of program priorities issued by headquarters. All program plans recognize the national interests served. Local and State interests are addressed to the extent that national perspectives and responsibilities are served."

The effective use of personnel and other resources, the maintenance of district viability, and the fulfillment of mission goals of the USGS and WRD require short- and long-range program planning. The District Chief has primary responsibility for this operation but is assisted and advised by the senior staff and the discipline specialists. In addition to the District Chief, the senior staff includes the Assistant District Chief for Investigations and Research, the Assistant District Chief for Operations and Technical Support, and the administrative officer. The Assistant District Chief for Investigations and Research determines what hydrologic inventories, investigations, and research are needed to satisfy national, regional, and local needs for hydrologic information and analysis. The Assistant District Chief for Operations and Technical Support ensures that data-collection sites operated by the district satisfy national, regional, and local needs.

Discipline specialists exercise responsibility for program planning by advising the District Chief on matters related to their particular field of expertise. They provide substantive recommendations on state-of-the-art methodologies, resources required to implement various technologies or study approaches, technical adequacy of study plans, and the likelihood of successfully meeting study objectives with available resources.

National needs are dictated by USGS and WRD mission goals. Each year, the WRD identifies priority program thrusts that are to receive special attention. These thrust topics are reviewed by the senior staff and discipline specialists to guide program development with local and other Federal cooperating agencies.

Regional and local priorities usually are determined in consultation with local, State, and other Federal agencies. The senior staff regularly visits these agencies to maintain a current awareness of the priority issues of concern. When possible, regional and lo-

cal priority concerns are considered in context with national priority goals established by headquarters. Regional and local issues that are not related directly to national priority goals are considered if they can be addressed within the framework of the USGS or WRD mission. Hydrologic issues that are clearly outside the USGS mission are not addressed.

Project chiefs, field office chiefs, and other members of the district staff are encouraged to discuss hydrologic programs with accredited cooperating agencies. No formal proposals are presented to potential cooperating agencies before review by the appropriate discipline specialists for technical adequacy, and by the District Chief for conformance with USGS mission goals.

Although the district does not prepare a formal long-range plan, it documents its intentions in an informal report, which is presented to the staff of the Office of the Regional Hydrologist at the annual program review meeting in the second or third quarter of each fiscal year. After review and approval by regional staff, program plans are developed into specific project proposals for consideration by cooperating agencies. After proposals receive approval from cooperating agencies and the appropriate regional staff, written agreements are prepared to formalize the plans.

PROJECT PLANNING

Quality-assurance policy: "Plans for new projects are developed in sufficient detail to allow adequate technical evaluation and review. Documentation of plans in project proposals is submitted to regional staff for review and acceptance before standard project-description forms are prepared for formal approval by region."

Project planning—an important element of the district's overall quality-assurance plan—involves formulation, review, and approval of a formal project proposal that is used to guide the conduct of the project. The project proposal is a written documentation of the project plans, and the project proposal cover sheet serves as formal documentation of review and approval of the plan by reviewing personnel.

Project proposal contents can vary considerably depending on complexity and scope of the planned activity; however, a proposal must contain sufficient information for the evaluation of its acceptability and adequacy. Acceptability means appropriateness of the project for WRD undertaking, its relation to regional or national issues, and the capability to undertake the work. Adequacy relates to the technical soundness of the proposal, the time allowed for completion, proposed report plans, the level of funding, and the proposed staffing.

At a minimum, project proposals contain a brief introductory section that outlines the need for the study, a concise statement of the project purpose, a description of the hydrologic conditions in the study area as they relate to the proposed work, and a relatively detailed description of the plan of study, including techniques or models to be used. In addition, proposals contain the description of the data required to apply the methodology, modifications to existing methods that might be required, and a description of all intermediate and final reports to result from the study.

Project proposals are usually written by the project chief. If a project chief has not been selected, several individuals, including discipline specialists, section chiefs, or other staff members, prepare the proposal independently or in collaboration. The proposals are reviewed by the appropriate discipline specialists and the section chief for technical adequacy and compliance with regional guidelines. After proposals have been reviewed and revised at the district level, formal approval from regional staff is requested. Thus, responsibility for the quality assurance of project proposals in the district is shared at several levels in WRD.

PROJECT IMPLEMENTATION

Quality-assurance policy: "Projects are implemented in accordance with a workplan, which is developed and approved for each project. The time allotted for developing the workplan depends on the length and complexity of the project, but the plan is approved before any substantive work is undertaken. Any significant deviations from the workplan require that the original plan be modified and reapproved."

After a proposed project has been approved by regional staff and funding has been arranged with a cooperating agency, the project chief completes a project description form and submits it to the Regional Hydrologist for approval. Project description forms are submitted within 30 days of project proposal approval or before the beginning date of the

project. After formal approval of the project description, the project chief prepares a workplan for the project.

The workplan is an expansion of the formally approved project proposal and project description. Although the formally approved documents serve as the written expression of the planning process for quality-assurance purposes, the workplan serves as the day-to-day operational framework for completing the project. It contains specific information on methods to be used, data-collection plans, field schedules, equipment and laboratory needs, personnel requirements, and budget requirements. Most importantly, the workplan contains a schedule of interim and final deadlines for various elements of the project. For most projects, the workplan describes report plans such as an initial estimate of the types of products, table of contents, list of illustrations, list of tables, and list of references. Workplans may even contain draft sections of the final report.

In developing various aspects of the workplan, the project chief collaborates with colleagues and consults with appropriate discipline specialists. The project chief meets with the Assistant District Chief for Investigations and Research and the chief of the Reports Unit to discuss report plans, arrange for base maps, schedule report production services, and develop a conceptual plan for the final report. The workplan is approved by the Assistant District Chief for Investigations and Research before substantive work is undertaken.

The general personnel requirements of the project are determined in the early stages of project planning and modified as the workplan is developed. As the need for each position on the project staff is established, selection procedures are initiated, and the staff is assembled. This process will normally overlap the process of developing the workplan.

The qualifications of project personnel relative to the technical demands of the work will be determined by the project chief and discipline specialist, and training to remedy deficiencies will be recommended. The discipline specialists will develop and document a specific plan to provide the required training, and the Assistant District Chief for Investigations and Research will be responsible for verifying that the required training actions were taken.

REVIEW AND REMEDIATION

Quality-assurance policy: "Data acquisition and processing and interpretive project work will be periodically reviewed to insure that appropriate quality control procedures are being followed. Remedial action will be taken to change workplans and procedures where this is necessary."

Project chiefs meet quarterly with the District Chief, section chief, discipline specialists, and others to discuss progress, problems, plans, modifications to the workplan, and, to a lesser degree, to ensure that project personnel are using appropriate methods to analyze and interpret data. The oral presentations are informal and discussion between the project chief and attendees is encouraged. Substantive suggestions are incorporated into the workplan to remedy identified problems with manpower availability, timeframe, funding, methodology, approach, data collection, training, analysis, or reports. The project chief will provide a written description of this meeting to the section chief, who will revise it if any changes in plans and procedures are needed. This document then will become part of a permanent project file.

If, during development of the initial workplan or in subsequent reviews, the project chief or district managers determine that methodology, funding, personnel, or timeframe is inadequate to fulfill the objectives of the project, reasonable alternatives are developed for consideration by cooperating agencies. These agencies are advised throughout the course of the project about any deviations from the original proposal. Significant changes in methodology, funding, personnel, timeframe, or final report(s) are discussed and documented in a revised workplan.

Formal technical review of projects is scheduled by the appropriate district discipline specialist at least three times over the term of the project, at the 10-, 40-, and 70-percent completion points in the project. For complex or technically innovative projects, more frequent review is scheduled. The intent of these reviews is to assure that appropriate analytical techniques are being used and to verify that conclusions drawn from the study are sound and well documented; these reviews are not concerned with personnel, funding, or timeframe problems as are the quarterly reviews. If problems are identified, the appropriate discipline specialist, the project chief, the section chief, and the District Chief will agree on remedial actions and, if

necessary, modify the workplan accordingly. The changes in plans then are reported to line managers at the appropriate level necessary to approve of the action taken. In addition, periodic discipline reviews by regional and headquarters personnel are conducted to ensure that district projects are carried out in an acceptable manner by qualified and trained personnel. In essence, this is a check on whether or not the district quality-assurance plan is being administered carefully.

DATA COLLECTION

Quality-assurance policy: "Data are collected using approved and documented procedures outlined in published division or district technical manuals or reports. Any exceptions to the use of these procedures are documented in writing and approved by the District Chief."

Routine data-collection activities of the USGS are conducted with the goal of obtaining accurate, precise, and impartial observations. To attain this goal, data-collection activities are performed in strict accordance with approved methods. "Techniques of Water-Resources Investigations" reports describe many of the field methods and procedures used in routine work. More specialized or nonstandard procedures are documented in other USGS report series or in professional journal articles.

In addition to guidelines in published reports, data-collection activities are governed by technical memorandums from headquarters, regional, and district offices. Each office is required to maintain a current file of technical memorandums describing field methods and to adopt those procedures when instructed. The Branch of Technical Development and Quality Systems maintains a file of all available technical memorandums.

During many hydrologic investigations, data-collection activities require nonstandard and innovative procedures. As a scientific agency, the USGS supports and encourages development of new methodologies, and investigators are encouraged to pursue new avenues of research and are rewarded for innovation and invention. However, new or modified procedures must be documented and submitted to appropriate discipline specialists and section chiefs for review and comment prior to implementation. Nonstandard techniques must be outlined in project workplans, and innovative methods must be described in reports. When nonstandard techniques are used, discipline specialists must review the proposed plans to document the precision and bias of information collected. The data collected to document precision and bias of information are included in final reports. Data collected by USGS contract observers represent a special case. The project chief in charge of such contracts has the responsibility to adequately train these contractors, take random measurements to check for the accuracy of the contractor's measurements, and enter these data into the National Water Information System (NWIS) or local data base.

Responsibility for ensuring compliance with data-collection policies ultimately lies with the District Chief. However, responsibility for reviewing data-collection activities, identifying deficiencies, and developing corrective measures has been delegated to the chief of each operating unit. Because data collection is basic to the successful accomplishment of the district's programs, chiefs of all field offices, operating units, and projects are responsible for quality assurance of data collected by their respective staffs. Chiefs review day-to-day field operations of their offices, units, and projects to ensure an acceptable level of performance by field personnel. The chiefs execute their responsibilities by using acceptable management practices to identify and rectify deficiencies in employee training and performance to ensure that data-collection efforts result in acceptable products that meet quality-control criteria. When chiefs determine that corrective actions are required to remedy quality-assurance problems, they have full authority to take necessary action, including remedial training, replication of work, or disciplinary measures. Substantive or recurring problems are reported to the District Chief for resolution.

Designated water-quality technicians in each field office are assigned special quality-assurance responsibilities for water-quality data-collection activities by their office chief. They review day-to-day water-quality data-collection activities of field personnel. When they identify deficiencies that could result in noncompliance with quality-control standards, they advise the responsible individual of the deficiency and provide a written statement to the field office chief for further review and corrective action. If further review substantiates the deficiencies, the field office chief advises the responsible individual of the problem and directs corrective measures to remedy the problem. Corrective

measures may include recollection of samples, remedial training, or removal of data.

The policies described have been designed for general use for most projects. In those few projects that need more specialized quality-assurance procedures because of severe environmental or legal considerations, the section and project chiefs, with the help of discipline specialists, should select and impose appropriate procedures from quality-assurance plans that have been written for more rigorously controlled projects throughout the Nation. The Yucca Mountain[1] and INEL projects, which have developed exacting quality-assurance documents, are examples of projects for which specialized quality-assurance plans were developed.

EQUIPMENT CALIBRATION AND MAINTENANCE

Quality-assurance policy: "Equipment and instruments used in hydrologic programs are maintained in serviceable condition and calibrated in accordance with guidelines documented in division or district procedural guides or manufacturer's instruction manuals."

Collection of hydrologic information onsite or in a laboratory involves the use of mechanical and electrical instruments that must be calibrated and maintained to ensure proper operation. Instructions, procedures, and quality-control practices are outlined in numerous field manuals, instructional guides, manufacturer's operating manuals, and district memorandums. All district employees who collect hydrologic measurements onsite or in a laboratory are responsible for proper maintenance of equipment in their care. Employees are required to read and practice guidelines for adjusting, calibrating, and testing instruments to ensure collection of reliable and accurate data. Supervisors are responsible for reviewing onsite and laboratory techniques of subordinates to ensure adherence to applicable guidelines. Supervisors prepare written statements documenting findings of reviews and ensure that identified deficiencies are corrected. Instructions on procedures used to check and calibrate water-quality instruments are kept by the district water-quality specialist.

All employees who measure specific conductance or pH in water samples are required to participate in the WRD National Field Quality Assurance Project by measuring and reporting these properties for standard solutions provided by the project. Employees who fail to meet an acceptable level of accuracy in reported measurements receive additional training and are required to repeat the test to demonstrate an acceptable level of performance.

[1]A project located near Las Vegas, Nevada, with scope and objectives similar to those of the INEL project.

DATA PROCESSING AND STORAGE

Quality-assurance policy: "All basic hydrologic data collected by or for the district are reviewed and certified as meeting division quality standards before entry into national data bases. Certified data are entered into appropriate data bases and made available for public use. Basic data that have not been reviewed and certified or that do not otherwise meet division quality standards are released for public use only with an appropriate disclaimer. Other types of (derived) data are released only after review and regional approval."

A generic definition of data is "something that is given from experience," but data are also "something on which inference or argument is based" (Webster). As such, data include not only gage- or well-site-measurement information (basic data) commonly stored in NWIS, but also include various levels of interpretive information (derived data), such as maps constructed from site data, input and output from calibrated models, and other products from which higher level inference is made. In like manner, a data base is not only a store of digital data files that can be made accessible to a computer, but also is a collection of paper files (maps, sections, calculations) structured so that entry, retrieval, storage, update, and linking functions exist.

Basic data

After collection by adequately trained and supervised personnel using approved methods and properly calibrated and maintained equipment, basic data are processed, stored, and archived in accordance with WRD and district guidelines. These procedures ensure integrity and prevent loss or damage to the data.

Primary records generally consist of field notes, recorder charts, laboratory reports, data from electronic recording or monitoring devices, and other forms of unedited data. The initial, unedited printed copy produced from various electronic data-recording

systems, rather than the electronic media or computer file, is considered to be the primary record. Primary records are considered to be historical information and are stored permanently for future reference. Information from streamflow-gaging stations is maintained in field office files for the current year and in the district central backfiles for previous years, information from wells and springs is stored in the statewide well-inventory file, water-quality laboratory records are maintained in the district water-quality file, and project files are maintained in Hydrologic and Environmental Studies central files. All primary records from hydrologic investigations are transferred to appropriate files before the conclusion of the project. Primary records are transferred to Federal archives if no immediate use for the information is anticipated. Archived records are inventoried carefully and cataloged to ensure that the records are retrievable. Most hydrologic data collected by the district are processed by computer programs on the district's minicomputer or workstation network.

The principal hydrologic data base (NWIS) maintained by the district currently contains several subsystems: ADAPS, GWSI, QWDATA, Aggregated Water Use Data System (AWUDS), and Site Specific Water Use Data System (SSWUDS). The respective data-base administrators are responsible for maintaining the district data bases and serving as technical advisors to users.

Responsibility for certification of data for entry into national data bases or for release to the public is assigned to the chiefs of the various sections or to individual discipline specialists. Responsibility for approving surface-water records is assigned to the chief of the Data Collection and Management Section. Responsibility for approving ground-water data is assigned to the ground-water specialist. Responsibility for approving surface-water-quality and sediment data and records is assigned to the water-quality specialist. If deficiencies are identified, the reviewer advises the responsible office or individual of the problem and requires recalculation of records to correct the problem.

All water-use data collected by the USGS will be collected according to established USGS procedures. All water-use data obtained by the district from other sources will be evaluated and rated prior to entry into USGS data bases or release to the public. The application of quality-assurance procedures to data obtained from other sources is much more difficult than application to data collected by the USGS. However, for water-use data to have any scientific worth, they must be obtained, evaluated, and reported under a clearly defined set of criteria. Regardless of the source of the data, the district water-use data file and subsequent water-use reports will contain evaluations of the precision, accuracy, completeness, representativeness, and comparability of the data.

It is the responsibility of all project personnel involved in the collection, compilation, or derivation of hydrologic and related data to follow the procedures described in district quality-control plans for each discipline and in the various references included in this document. Project practices are reviewed by the section chief during progress reports and before any reports are approved for publication. Data-management quality assurance will be described as an element in the performance standards of most project personnel.

District data bases periodically are uploaded to the national data bases by the respective data-base administrator. Frequency of updates depends upon the kinds of data, the status of review and certification, and the district workload. District policy is to keep national files as current as possible. Updates are made no later than 6 months after the end of the water year.

Selected field and laboratory data collected by another agency but used in a USGS program may be stored in National Water Data Storage and Retrieval System (WATSTORE) and NWIS, provided they are carefully reviewed, meet the standards set by the USGS, and are approved by the District Chief. The responsibility for ensuring that these data meet USGS standards rests with the project chief, who may consult with district discipline specialists or the chief of the Branch of Technical Development and Quality Systems.

Derived data

A wide variety of paper, digital, photographic, and other records created during project work are interpreted to meet project objectives. These records constitute various levels of derived data and can consist of maps, hydrologic sections, calculations, photomaps, and so forth. Some of this information is distributed data (defined in terms of X, Y, and Z) and is published in the body of interpretive or data reports to give the reader a clearer picture of the system being evaluated. Other derived data are seldom published, but they remain important sources of information for

verifying project results after publishing or for later work in a project area. These data are to be archived by the project chief in accordance with district quality-control policies after an inventory ensures the data are retrievable. If a numerical model is calibrated and predictive scenarios are run, or if a model is used in an analysis of transport, in calculating recharge, rainfall-runoff, or other process, an archiving report or a data appendix to the interpretive report is written and published by the project chief in accordance with appropriate district quality-control policies.

Responsibility for approving inclusion of derived information in national data bases rests with the Assistant District Chief for Investigations and Research, Assistant District Chief for Operations and Technical Support, or the appropriate data-base administrator. The responsible individual may seek technical assistance from district, regional, or headquarters discipline specialists for review, but no derived data are published or stored without adequate qualifying notation.

DATA ANALYSIS, INTERPRETATION, AND SYNTHESIS

Quality-assurance policy: "Data are analyzed, interpreted, or synthesized in accordance with procedures documented in division technical reports or other citable references. Innovative or undocumented procedures may be used if the techniques are adequately described in the project workplan and are included in the final report. All synthesized or derived data are clearly differentiated from measured data."

Analysis and interpretation of data involve a broad spectrum of activities ranging from relatively straightforward application of statistical programs to development of complex, multidisciplinary models of hydrologic systems. Scientific curiosity and innovative thinking are important attributes in selecting or developing effective methods to analyze and interpret data. Therefore, the district policy is designed to encourage research and development of new technologies by not limiting interpretive procedures to a standardized list. In general, any procedure that has been described in WRD technical reports or has been published in a citable document is acceptable for the analysis and interpretation of data. If a published procedure is modified substantially or if an innovative procedure is proposed, the investigator is required to describe the procedure in the project workplan and to discuss the methodology in a final report. The adequacy of the procedure is evaluated by technical reviewers.

Each project chief is responsible for selecting the appropriate interpretive tools for assigned projects. The project chief searches the literature for citable documentation of the methods to be applied or prepares a detailed description of the methods for review by discipline specialists. The Assistant District Chief for Investigations and Research is responsible for ensuring that appropriate technical review and approval are obtained before the investigation begins. If district discipline specialists do not have the requisite expertise to review and approve the proposed methodology, outside assistance from regional or headquarters staff is solicited. The Assistant District Chief for Investigations and Research approves or rejects proposed methodologies or techniques after review of recommendations or comments obtained from technical advisors. The decision is based on technical soundness of the methodology proposed and the resources available to perform the work.

REPORT PREPARATION AND PROCESSING

Quality-assurance policy: "Reports prepared by the Idaho District are processed in accordance with WRD and district publication guidelines. Interpretive reports must meet WRD and regional technical, editorial, mechanical, and policy requirements before transmittal for Director's or regional approval."

Reports are one of the WRD's most important products. They provide a tangible measure of our productivity and inform the public of our findings. A properly written report describes procedures that are used to reach conclusions and, as such, serves as the written documentation of the quality-assurance efforts used in the project or program.

All interpretive reports prepared by the WRD must be approved by the Regional Hydrologist for the Director of the USGS before they are released to the public. Before a report is submitted for approval, it passes through a rigorous review system designed to ensure technical adequacy and editorial quality. The District Chief ensures that all reports meet requirements for approval before transmittal for approval.

The District Chief has been delegated the authority to approve noninterpretive reports. Approval is

granted if the reports meet all the requirements for technical adequacy, internal consistency, editorial quality, and policy criteria. The District Chief ensures that district-approved reports do not contain interpretive material or analysis that would require a higher level of approval for release.

Detailed guidelines for preparing and processing reports are contained in division publications and memorandums. These guidelines provide specific instructions and requirements for text, illustrations, and tables. Every author is required to read and follow the guidelines.

Report production begins at the earliest stages of the project with the development of a report outline, lists of proposed illustrations and tables, and preparation of the introductory section of the report. The text is written and illustrations and tables are prepared as study components are completed. Ideally, the final report will be in draft form 6 months before the scheduled end of the project to allow adequate time for report processing and approval. Anticipated deviations from the stated deadline for completion of draft reports will be reported by the project chief to the Assistant District Chief for Investigations and Research at least 3 months before the scheduled due date of the draft report to allow time to rectify scheduling problems or modify deadlines.

Division policy places the primary responsibility for report accountability with the author. However, several individuals have responsibility to assist the author in meeting the assigned task of preparing technically sound and editorially correct manuscripts. The district reports specialist ensures that the manuscript is ready for colleague and editorial review. Colleague reviewers are responsible for identifying any problems with technical content. The chief of the Reports Unit is responsible for ensuring that report packages are ready for approval by the Regional Hydrologist. If any editorial or verification problems are noted, or if any deficiencies are noted in author's responses to review comments, the chief of the Reports Unit notifies the senior author in writing. A copy of the notice is provided to the Assistant District Chief for Investigations and Research, who verifies the completion of required actions. The Assistant District Chief for Investigations and Research also is responsible for ensuring that technical reviews are adequate and that author responses are appropriate. The District Chief is responsible for ensuring that all participants in the review process perform their duties adequately.

TRAINING

Quality-assurance policy: "Idaho District employees receive adequate training to perform their assigned tasks."

Training is an integral part of the district's quality-assurance program. Employees are not assigned tasks for which they are not adequately trained. The responsibility for ensuring that employees are adequately trained is shared jointly by the employee, the employee's supervisor, the discipline specialists, the district training officer, and the senior staff.

A formal training plan is prepared for each employee as part of the employee's Career Documentation Profile. The employee is expected to participate in development of the training plan by identifying training needs and topics of personal interest. The employee's supervisor discusses training needs with the employee during the annual performance appraisal process and documents training needs. The district training officer compiles a list of employee training needs and requests consideration by the District Chief. The District Chief and the senior staff make selections for training by weighing program plans, employee skills, and project requirements against funds available to support training activities.

The district considers workshops, conferences, National Training Center courses, correspondence courses, university courses, and inhouse discipline seminars as formal training. All formal training is recognized and entered into the employee's Career Documentation Profile and other personnel records. Training records are updated within a month of completion of training. Employees are responsible for updating their own Career Documentation Profiles.

Although each employee is encouraged to document on-the-job experience in the autobiographical part of the Career Documentation Profile, work-related experience is normally not recognized as formal training. On-the-job training generally is provided by project chiefs, senior staff members, or discipline specialists. Supervisors identify employee skill deficiencies and arrange on-the-job training to remedy any identified lack of training.

Allocation of funds to support training activities is the responsibility of the District Chief. Decisions on employee training are made on the basis of recommendations from supervisors, requests from employees, and availability of funds.

SUMMARY

The mission of the WRD is to provide hydrologic information and understanding needed for optimum utilization and management of the Nation's water resources for the overall benefit of the people of the United States. The WRD has implemented a policy to ensure that all scientific work performed by or for the WRD is conducted in accordance with a centrally managed quality-assurance program. As a part of that program, each district office is required to prepare a written district quality-assurance plan. This report establishes and documents a formal policy for the conduct of quality assurance within the Idaho District of the USGS by describing district organization and operational responsibilities, documenting the district quality-assurance policies, and describing district operations and the quality-assurance responsibilities for performing those operations.

The district quality-assurance plan does not describe all of the detailed technical activities that are commonly termed "quality-control procedures." Instead, the plan focuses on policies, operations, and responsibilities that are implemented at the management level. Contents of the plan are reviewed annually and updated as programs and functions change.

The district conducts its work through offices in Boise, Idaho Falls, Twin Falls, Sandpoint, and at the INEL. Hydrologic data-collection programs and interpretive studies are conducted by two operating units and three support units. Operating units are responsible for implementation and execution of district projects, and support units provide operational and technical assistance. Administrative Services provides guidance on various personnel issues and budget functions. Computer and reports advisors provide guidance in their respective fields. Discipline specialists provide technical advice and assistance to the district and to chiefs of various projects.

Hydrologic work performed by and for the Idaho District is required to satisfy the district quality-assurance policy, which states that all investigations are to be conducted in a manner that results in data of known quality, following the policies and technical directives of the USGS, WRD. That policy is supported by a series of policy statements that describe responsibilities for specific operations in the district's program. The operations are program planning; project planning; project implementation; review and remediation; data collection; equipment calibration and maintenance; data processing and storage; data analysis, synthesis, and interpretation; report preparation and processing; and training. Not all activities include every element, but all conform to the quality-assurance policies that are appropriate to successful completion of the activity.

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