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Information Management System for the California State Water Resources Control Board (SWRCB)

T. C. Heald and G. H. Redmann

Data Systems Division

A study was made to establish the requirements for an integrated state-wide information management system for water quality control and water quality rights for the State of California. The data sources and end requirements were analyzed for the data collected and used by the numerous agencies, both State and Federal, as well as the *nine Regional Boards under the jurisdiction of the State Board*. The report details the data interfaces and outlines the system design. A program plan and statement of work for implementation of the project is included.

Introduction

The extraordinary growth in population, resulting in increased industry, irrigated agriculture, and the ever-growing demands for water-oriented recreation has increased water use at a tremendous rate. Unless new and better ways of reducing pollution and managing water resources are found, the nation not only faces the potential of having a water-limited economy but also complete crisis of the water environment.

In California, the State Water Resources Control Board (SWRCB) is designated as the State Water Pollution Control Agency for all purposes stated in the Federal Water Pollution Control Act. The State Water Quality Control Act states that "The health, safety, and welfare of the people requires (sic) there be a statewide program for the control of the quality of all waters in the state."

To meet this requirement, the SWRCB entered into an agreement with JPL to perform a joint study to formulate the State Board's data management needs for an information system and to outline the system design, including the development of cost estimates and an implementation plan/schedule.

Study Constraints

In keeping with the desire to implement the data management system as early as possible and with maximum use of existing hardware, the following constraints were applied:

1. Use the STORET system of computer programs operated and controlled by the Environmental Protection Agency (EPA), Office of Water Quality (OWQ).
2. Use the existing California Department of Water Resources (DWR) computer system.
3. Use a combination of both systems.

Approach

The formulation of a data system for the SWRCB required the gathering of information from numerous sources. Many types of data generated, collected, and stored in separate agency offices are important in conducting a comprehensive analysis of water quality within the State. Representatives from all major offices and agencies having responsibility and/or a vested interest in water quality management were interviewed and the information obtained from these offices was compiled and analyzed. From this information the basis for this integrated data system was developed.

Existing Information Flow

Discussions with the agencies and departments concerned revealed that a wealth of data is being gathered by the different organizations. Several groups are gathering data on water quality, and there is a considerable amount of data on related matters such as flow rates, land use, and withdrawal rate. Although individual organizations have responsibilities relating to the reporting of the data that they gather, the capability for interpretation and use of data would be greatly enhanced if the data were correlated with similar data gathered from other agencies. The exchange of data between agencies is essential to the comprehensive analysis of water quality. Figure 1 represents the collection of data by various agencies. It can be seen that all such data are a measure of water quality.

Proposed Information System

A central data processing system, utilizing a high-speed computer with data storage on magnetic tape and disk, could provide rapid access to most of the information that is being collected. Such a computerized system also would have the capability for processing the data to provide statistical summaries of water quality trends and would provide alarms when pollution increased to dangerous levels or decreasing flow rates were imminent. Figure 2 displays the way data can be gathered and distributed from a central system.

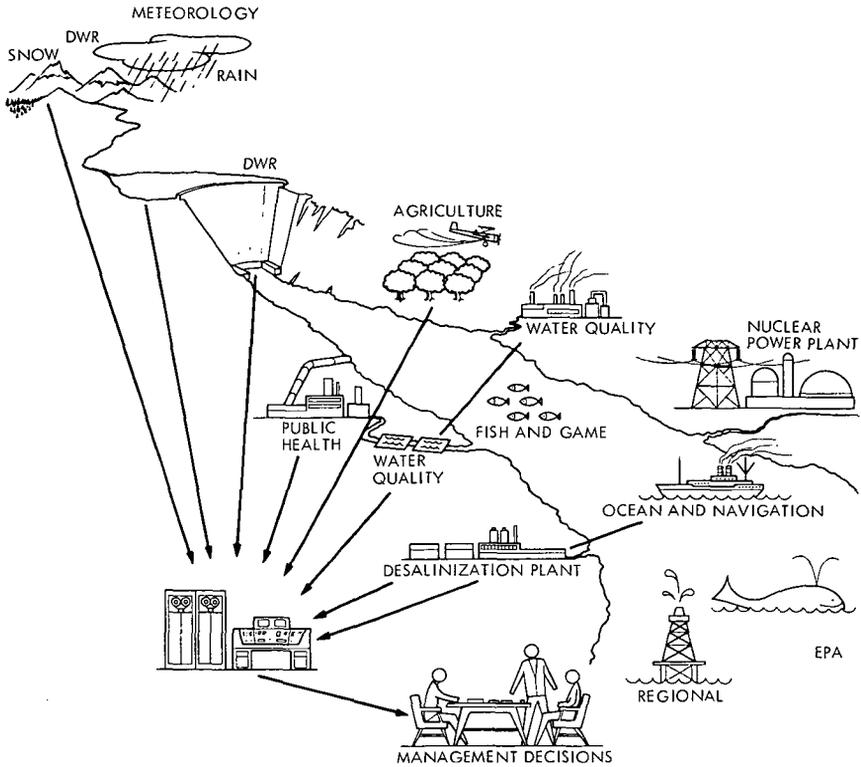
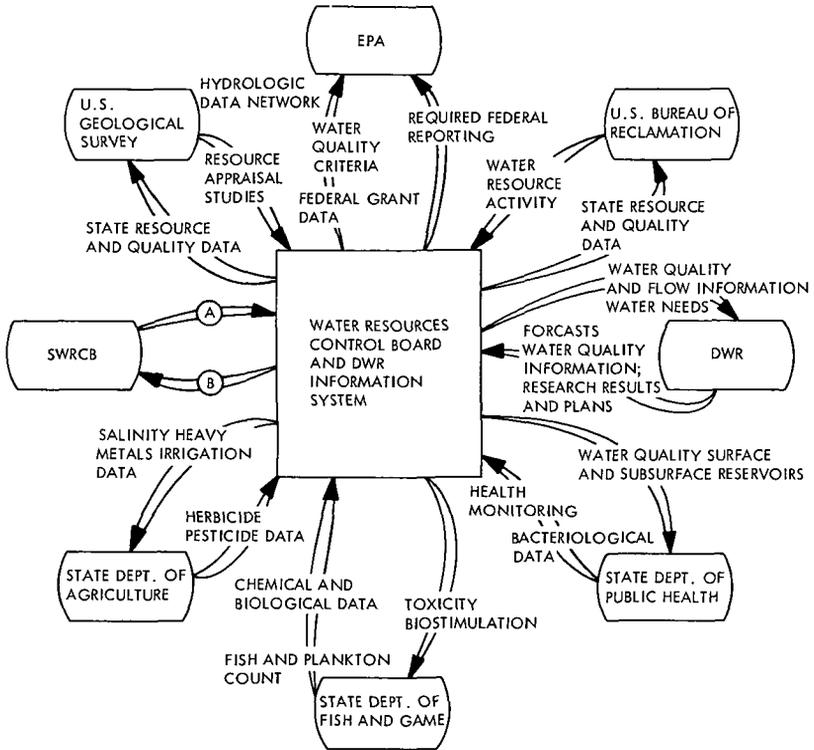


Fig. 1. Data network

Data System Development

An information management system must have as its foundation a stored data base, consisting of several files, containing all of the data required to analyze a particular subject. It is not necessary that all of the files be accessible to an instant inquiry on an interactive basis, although it is necessary that all files be available to the interactive portion of the data base. The overhead involved in a complete information system is great in storage and core requirements; therefore, only the central and most pertinent data files should be stored and retrieved with an interactive system, while the rest of the data base is accessible by batch programming methods.

The proposed data system relates directly to the needs of the State and Regional Boards. The system should interface automatically with the DWR data base to form one large bank of data bases containing all the information necessary for management decisions.



(A) WATER RESOURCES CONTROL BOARD

- PLANNING AND RESEARCH
INFORMATION REQUESTS, SYSTEM PLANS,
QUALITY GUIDELINES, AND RESEARCH RESULTS
- REGION 2 BOARD
SELF-MONITORING DATA AND COMPLIANCE,
CONTINUOUS MONITORING OF BAY DELTA
- REGION 4 BOARD
SELF-MONITORING DATA AND COMPLIANCE,
CONTINUOUS MONITORING OF L.A. HARBOR,
BIOLOGICAL DATA
- REGION 6 BOARD
SITUATION IN TAHOE
- OTHER BOARDS
SELF-MONITORING DATA IS REQUIRED
- WATER RIGHTS
WELL USERS AND WITHDRAWALS, FORECASTS
OF GROUND WATER SUPPLIES
- PUBLIC EDUCATION
REQUESTS FOR INFORMATION
- WATER QUALITY CONTROL MODELING
FORECASTS
- GRANTS ADMINISTRATION
REPORTING AND CONSTRUCTION STANDARDS

(B) WATER RESOURCES CONTROL BOARD

- PLANNING AND RESEARCH
WATER QUALITY DATA, FORECASTS,
TREATMENT PLANT PROGRESS
- REGION 2 BOARD
QUALITY STANDARDS, FORECASTS
- REGION 4 BOARD
QUALITY STANDARDS, FORECASTS
- REGION 6 BOARD
LAND USE INFORMATION AND RELATED
SITUATION FORECASTS
- OTHER BOARDS
QUALITY STANDARDS
- WATER RIGHTS
QUALITY STANDARDS
- PUBLIC EDUCATION
WATER QUALITY INFORMATION,
TREATMENT PLANT PROGRESS
FORECASTS
- WATER QUALITY CONTROL MODELING
WATER QUALITY INFORMATION
- GRANTS ADMINISTRATION
QUALITY STANDARDS

Fig. 2. Data interfaces

It is assumed that most of the terminal inquiry needs are in the Regional and State Board divisions. To satisfy these needs, the described system is structured with interactive files for terminal inquiry and batch files in combination with interactive files for analytical and statistical studies.

The files that make up the interactive portion of the data base contain the information that is most in demand by the regional offices. These files should be stored and retrieved with a data management system that allows both on-line terminal inquiry and information manipulation with conditional parameters. The requirement for a report-generating capability is important in formatting data to the terminal.

The remaining files in the data base contain all of the other information necessary for comprehensive analytical studies. These files may be stored either on tape or on direct access devices, but they must interface with the interactive portion of the data base through the use of compatible identification coding (Fig. 3).

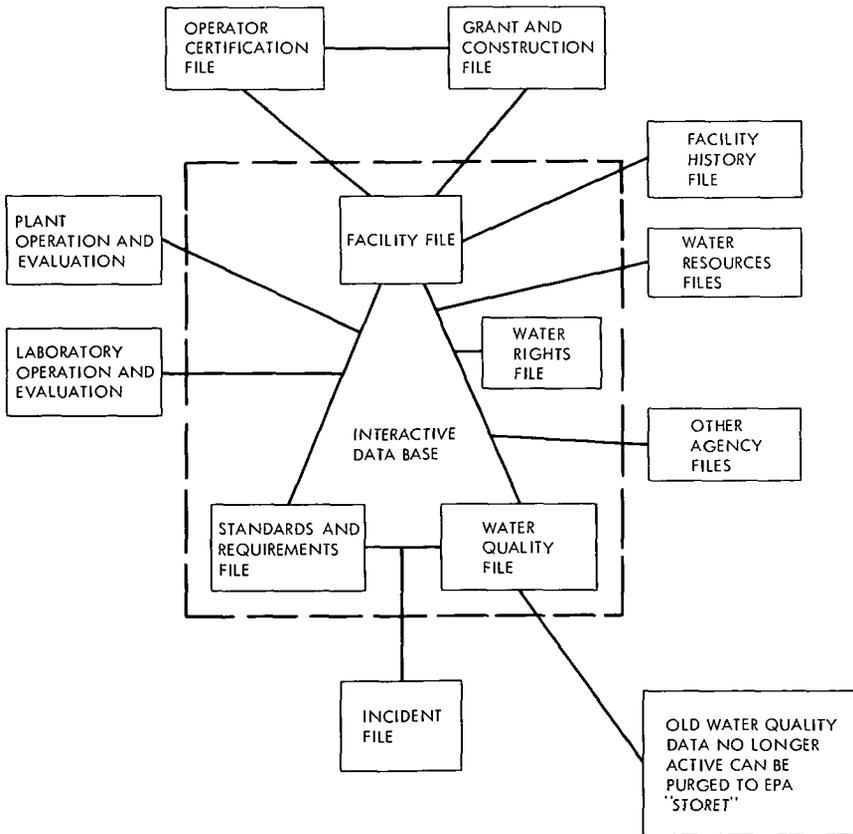


Fig. 3. Data base file structure

It is important that the detail design of the system take into consideration the expansion of data parameters on any file. The advantage of using an information system such as MARS III is that the files can be reformatted and restructured with very little impact upon the total system. Provisions should be made in the system design so that any of the information files can be made a part of the interactive portion of the data base with very little impact upon the total system.

Identification Coding

A coding structure for identification by location must be designed before any correlation of data can be made. This identification code must incorporate the present methods used by FWQA and DWR in addition to other in-depth coding. The coding should be designed so that correlation can be made by all or any combination of the identification codes. For full correlation of data, the identification coding should include, but not be limited to, the following items:

- (1) Region.
- (2) Basin.
- (3) Sub-basin.
- (4) Stream number.
- (5) Mileage from mouth.
- (6) Latitude.
- (7) Longitude.
- (8) Surface or sub-surface.
- (9) Depth (if sub-surface).
- (10) Station number.
- (11) Discharger number.

Data Base Description

The requirements of the regional offices are so varied that rapid terminal access of data base information is a necessity. The ability to manipulate and format the data by the use of conditional parameters is a necessary requirement. The data base file structure is shown in Fig. 3.

The *Interactive Data Base* is described as follows: as the flow of data concerning water quality measurements enters the Water Quality File, the parameters can be automatically compared to the requirements for each parameter on the Standards and Requirements File and the engineering data on the Facilities File. This comparison can then establish variances from the base line and perform trend analysis and produce alarms when required. This process, over a period of time, can also perform evaluations on plant and laboratory operations.

The *Facility File* contains all of the administrative and technical descriptions of a discharge facility. This data includes process type, type of discharge, financial and manpower requirements, and compliance information.

The *Water Quality File* contains all of the quantitative and qualitative laboratory analysis data obtained from self-monitoring stations, regional test samples, and automatic monitoring devices.

The *Standards and Requirements File* contains all of the requirements and regulations established for each location. All regulated water quality data would be compared to the standards to determine compliance.

The *Water Rights File* contains data concerning regulated withdrawals from public surface and ground waters.

Output Reporting Requirements

The reporting requirements of this system are many and varied. There are requirements for detail reporting in many areas. Engineers have a need for baseline and trend reports. All offices have requirements for summary reporting capabilities. Graphic representation is required by both the State and Regional Offices. Statistical reports are required by management in all areas. The State and Regional Offices in research and special studies need modeling and simulation capabilities. The described data system provides the data necessary for all of these requirements. Some of the reports to be supplied by the system to various offices and agencies are:

- (1) Periodic summary reports.
- (2) Baseline and trend reports.
- (3) Graphical time/performance reports.
- (4) Evaluation reports on operators and laboratories.
- (5) Source water quality and flow-rate reports.
- (6) Statistical reporting involving history and trends.
- (7) Data for quality basin modeling and simulation.
- (8) Summaries of withdrawals.
- (9) Prediction of downstream effects of withdrawals.
- (10) Reporting required by EPA-OWQ.
- (11) Special request by condition code.
- (12) Land use reports and forecasts.
- (13) Pesticide reporting.
- (14) Incident reporting.

Future Expansion of System Capabilities

A study was performed to determine the impact of automatic sensing and monitoring upon any central system. The joint proposal submitted by Region 2 and USGS for three monitoring stations in the San Francisco Bay Region was used as a basis for the study. Each station was to be interrogated every two hours by a central station. Each station was to monitor six parameters: (1) tide gauge, (2) temperature, (3) pH, (4) dissolved oxygen, (5) turbidity, and (6) chlorides.

The study produced an alternative computer-controlled data acquisition system that could be used and could be tied to the central information system. A program would be required in the system to screen this data to store only trend and variance information. The alternative sensing and monitoring system is described in Fig. 4.

The requirements were examined from the point of view of a general purpose computer-controlled data acquisition problem rather than from a water quality sensor problem. Because the remote stations would be fixed,

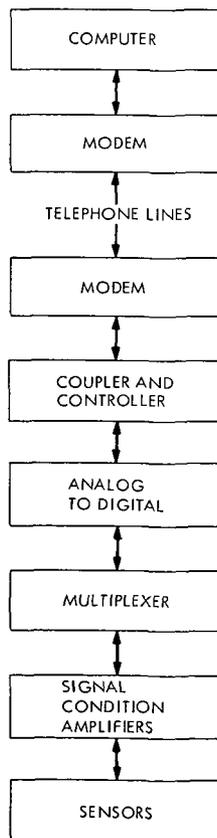


Fig. 4. Computer-controlled data acquisition system

land based, and capable of housing equipment in a protected environment, only commercial off-the-shelf data systems were considered. Additionally, due to funding constraints, communications between the remote stations and the central station were considered restricted to common-carrier switched telephone circuits.