WATER QUALITY MANAGEMENT DECISIONS IN COLORADO

by

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and Robert C. Ward

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Completion Report

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ABSTRACT

WATER QUALITY MANAGEMENT DECISIONS
IN COLORADO

An evaluation of Colorado's present water quality monitoring system has been made, as well as the capability of present institutional programs to anticipate potential pollution problems, and recommendations have been made for alternative pollution enforcement methods. Both Federal and State legislative history pertinent to Colorado water pollution problems have been delineated. Primary emphasis has been given to the South Platte River Basin, because it represents the most severe combination of municipal, industrial, and agricultural pollution problems in Colorado.

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KEYWORDS - administration, *administrative agencies, institutions, law enforcement, regulation, stream pollution, water pollution, *water pollution control, water quality, *water quality control.

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Funding was obtained from the Environmental Protection Agency for the project, "Data Acquisition Systems in Water Quality Management." This project was completed under the leadership of Dr. Robert C. Ward. This project developed design procedures for state-wide water quality surveillance systems. The results were applied in developing a dual water quality data collection network for Colorado.

A large portion of the work reported herein is a summary of the extensive efforts by Steven R. Nichols. His efforts, while a Graduate Research Assistant in the Agricultural Engineering Department, have contributed largely to the success of this research effort. That portion of Nichols' efforts pertaining to water quality data collection are reported in his M.S. thesis, "Water Pollution: South Platte River."

The reports by Ward (1971a) and Nichols (1972a), combined with this report, constitute the present results of the research efforts pertaining to Colorado's water pollution program. In addition, another research project, "Institutional

Requirements for Optimal Water Quality Management in Arid Urban Areas," is underway. This effort is principally concerned with the Denver metropolitan area. The results of this effort will be reported in June 1973.

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Gaylord V. Skogerboe
Principal Investigator

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INTRODUCTION

Purpose

The ways and means to handle the problem of water pollution control are well established in the policy making and political structure of the United States. Colorado, as well, has recognized the need for pollution control from both her own initiative and the requirements of the Federal Government.

This analysis is an effort to critique the technical and managerial aspects of the water quality control structure which has developed and is currently in operation in the State of Colorado.

Conceptually, the intent of this document is to evaluate the origins of the policy for water pollution control which have established mechanisms to solve the related problems of control. From the evidence of data and examples of enforcement, the resulting accomplishments of the pollution control mechanisms may then be evaluated. By comparing the findings of such an evaluation with the original intent and purpose of the law, the effectiveness of programs may be evaluated.

As a final step, then, the problems which have interfered with the attainment of the legal goals may be established and problem remedies proposed.

Objectives

To accomplish the purpose of this study, the following objectives were delineated in the original project outline:

1. Evaluate Colorado's present monitoring system for surveillance of stream standards with respect to both present and potential sources of pollution.
2. Evaluate the capability of present institutional programs to anticipate potential pollution problems and for providing information necessary in decision-making regarding water quality management.
3. Evaluate present and projected institutional processes for pollution enforcement in Colorado, along with alternative methods for attaining conformance with stream standards.

Scope

The type of water quality problems encountered in Colorado vary from one drainage basin to another. In the Colorado River Basin, salinity is the primary pollutant, with damages occurring primarily downstream in California and Mexico. Salinity is also a problem in the Rio Grande Basin, while municipal, industrial and agricultural wastes are a problem in the Arkansas River Basin. But the South Platte River Basin constitutes the major water quality problem in Colorado.

Primary emphasis has been given to the South Platte River Basin in this study because it contains most of the

people in Colorado, has a history of serious water quality problems, and faces increasing water demands, which will require a greater cognizance of water quantity and quality management. The South Platte and its tributaries drain the most populous and industrialized portion of the State. The pollutants from the cities and industries, along with wastes from irrigated agriculture and agricultural industries (e.g., sugar beet processing and feedlots), result in the most severe pollution problem in Colorado.

Nichols (1972a) has made extensive analysis of water pollution legislative history pertaining to the South Platte River Basin. Nichols dealt with the various aspects of policy formation and developed an approach for evaluating the effectiveness of the water pollution control programs in Colorado from a technical standpoint.

Ward (1971a) then applied Nichols' findings to actually measure the efficiency of the data collection operation in Colorado in terms of its ability to detect and curtail water pollution. The work by Ward pertains to the design of statewide water quality surveillance systems, with particular emphasis upon a dual water quality monitoring data collection network for Colorado.

This report will first review the origins of the current water pollution control structure, summarize Nichols' and Ward's work, and then propose remedies for improving the system to achieve effective water pollution control. In addition, alternative management methods will be considered.

Presentation

To meet the objectives of the analysis, namely history, evaluation, and proposed solutions, the sections are divided accordingly. Section 2 summarizes the history of policy formation and the resultant structure for water pollution control, while Section 3 evaluates the accomplishments and effectiveness of the water pollution control structure. Finally, Section 4 discusses solutions to problem areas utilizing alternative management methods, with recommendations being made for each method of operation.

Qualifications

There are three fundamental areas which must be qualified prior to the presentation of the analysis. The first point is that the analysis is made from an outsider's viewpoint. The authors did not have the advantage of being involved in the workings of the actual system. Therefore, the authors have no in-house experience from which they would have a much better concept of the day-to-day compromises and half measures necessary to the operation of the pollution control system.

The second qualification is that the following analysis was made from a technical standpoint. The authors are all engineers and therefore have backgrounds and training in methods of technical analysis. The method of analysis, therefore, will tend to be more pragmatic than if performed by persons with different backgrounds.

The final point of qualification is that the authors' intent in this report is not to criticize personalities or operations. Rather, the intent is to critique the operation of the system from the above qualified standpoint and provide a perspective not normally available from an internal point of view. Hopefully, the perspective can serve as a guide for developing a water pollution control strategy in Colorado that is both effective and efficient in performing its duties.

SECTION 2

LEGISLATIVE REVIEW

Rather than review all details of the various legislative acts (both State and Federal) which have had an impact on Colorado's current water quality management program, only those that are of major significance will be discussed here. Nichols (1972a) has prepared a more detailed review of all legislation.

Federal Legislation

For a long period of time, the Federal Government has been the initiating legal backbone to environmental protection generally and water pollution control in particular in the United States. Through a long and complex involvement with environmental problems of various forms, the congressional, executive and judiciary branches of government have evolved an increasingly ubiquitous system of legislation.

The Federal action has resulted in a series of Acts that began in 1899. For the sake of comparison, the intent and policy of water pollution legislation through 1966 is listed below.

River and Harbor Act of 1899

Established the unlawfulness of discharging any refuse matter into any navigable water in the United States.

Oil Pollution Act of 1924

Protects navigation from obstruction and injury by preventing the discharge of oil into the coastal navigable waters of the United States.

Water Pollution Control Act of 1948

Establishes the policy of the Congress to preserve states' rights and prevent pollution of water bodies primarily for health protection. Also establishes the format of the enforcement conference procedure.

Water Pollution Control Act Extension of 1952 and Water Pollution Control Act Amendments of 1956

Extends and reiterates Congress' stand on protecting states' rights with financial aid for research again primarily directed toward health hazards.

Federal Water Pollution Control Act of 1961

Broadens the scope of water pollution control to include projects for water storage, suggesting a trend to the "multi-purpose" philosophy. Also, opens the door for cooperative Federal-State investigations.

The Oil Pollution Act of 1961 and Amendments to the Oil Pollution Act of 1961

Extends the oil pollution policy to international waters.

The Water Quality Act of 1965

Dissolves the states' autonomy in dealing with pollution problems and establishes a national policy for pollution abatement within the states for esthetic and health reasons. Requires state adoption of water quality criteria and plans of implementation and enforcement subject to Federal approval.

The Clean Waters Restoration Act of 1966

Extends and improves the 1965 Act and also lifts the ceiling on grant size for water pollution control projects.

The most significant Acts are those of 1948 and 1956 which established the enforcement conference procedure and the Act of 1965 which created a national water quality control policy. Public Law 80-845, the 1948 Act, gave authority for water pollution control activities to the Public Health Service. The Surgeon General was authorized to develop a comprehensive program for eliminating or reducing pollution of interstate waters, which included all lakes, rivers and other bodies of water which either flowed across or formed part of state boundaries, and their tributaries. The expressed purpose of abating pollution, as stated, is to reduce health hazards connected with impure water. No mention is made of esthetics, recreation or any other purpose except health.

Provisions were made for the establishment of a Water Pollution Control Advisory Board. The Surgeon General was to chair the board of four Federal representatives from the Army, Interior, Federal Works Agency, and Department of Agriculture. Six non-Federal members were appointed by the President.

Provisions for pollution abatement action to be taken by the Federal Government were also established in the 1948 Act. The state or interstate agencies involved had to give consent and be included in initiating all action. Apparently, this procedure was not used until after 1956.

In the Act, the Surgeon General was directed to encourage cooperation in and between states to adopt comprehensive programs for abatement of water pollution. The Federal function was to more or less provide technical services at the request of states.

The Surgeon General, on the basis of reports, surveys, and studies, was authorized to take action if he "found" pollution of interstate waters which endangered the health and welfare of the people of a state. The polluter was given first notification of recommended remedial action to abate and given a reasonable period of time to comply. If no action was taken to abate, the Federal Security Administrator was authorized to call the matter before a five-man board. On the basis of evidence presented at a hearing before the board, further action was recommended to the Administrator. Again, if after a second notification and a

reasonable period of time, the polluter did not comply, the Attorney General brought suit on behalf of the United States.

Two important points should be mentioned. First, it was necessary to prove that pollution was of a character to endanger "health and welfare" and then to prove compliance had been met. No provision is promulgated which describes the nature of that evidence. Second, no procedure was outlined to monitor whether or not the polluter remained in compliance. In other words, no system was established which could monitor, on a continuing basis, the water quality of the stream in question. The lack of such a monitoring system is symptomatic of a basic failure at the Federal level to guide the states in forming water pollution control agencies with effective administrative means to deal with water pollution problems.

Ineffectiveness of the 1948 Act was recognized in 1956 by the House Appropriations Committee who refused new funding to the Public Health Service for enforcement. In fact, the 1948 loan system was approved, but never funded. Upon this point, states' rights versus Federal authority, the Department of Health, Education, and Welfare negotiated a format which established a Federal procedure by first calling a public hearing, followed by a six-month waiting period, a possible six-month extension, and then, finally, court action as previously described. The 1956 Act did not remove the requisite for state permission before court action.

There were several significant changes in the 1956 Act. The phrase "prevention and control" was substituted for the term "abatement," which had described the objective statements. A significant phrase ". . . primary responsibilities and rights of the States in preventing and controlling water pollution . . ." is still preserved in the 1956 version of the law. This slight wording change alters the Federal policy from a reactive to a preventive point of attack (Water Pollution Control Act Amendments of 1956, PL84-660).

A significant revision of the procedure for Federal participation in pollution problems was included in the 1956 Amendments. A statement was included as in 1948 to preserve states' rights. The notification procedure remained essentially the same, but after notification of the state or interstate pollution control agency, the Surgeon General was directed to "call promptly a conference of the State water pollution control agencies and interstate agencies . . ." of the states affected by the pollution. Following the conference, the Surgeon General was to prepare a summary of the conference discussion, including a statement of the occurrence of pollution, the adequacy of measures taken toward abatement, and the nature of delays encountered in abating the pollution. The conference could be reconvened at any time (Water Pollution Control Act Amendments of 1956, PL84-660).

The next major legislation at the Federal level is the Water Quality Act of 1965. First, water pollution control

was placed under the jurisdiction of a new agency within HEW; the Federal Water Pollution Control Administration (FWPCA). This, in itself, demonstrates Federal acknowledgment that water pollution is an issue of special national concern. Second, Federal policy was changed from careful protection of states' rights to using Federal legislation to force the states into considering, establishing, and implementing water pollution abatement plans, a point of great significance as evidenced by subsequent Colorado legislation. Previous water pollution acts were authorized only to encourage "cooperation among states" and "assist states in prevention and control."

The 1965 Act required the Governor of the state to file a letter of intent within one year after October 2, 1965 to adopt on or before June 30, 1967 water quality criteria to be applicable to interstate waters or portions thereof within the state and a plan for implementation and enforcement of those water quality criteria adopted. Upon approval of the Secretary of HEW, the criteria and plan then became the state's water quality standards.

If the state did not develop these standards and submit the plan of implementation, the Secretary could then do so. Not only was the intent of the Act to prevent and control pollution as before, but also to enhance or actually improve water quality. This is the so-called "non-degradation" clause which met strong opposition from the western governors. Technically, to the western states this meant no more development of water resources.

Contained in the 1965 Act were several significant points. Most significant of all perhaps is the fact that Congress required stream standards and not effluent standards. Each poses formidable technical and political problems for adoption, implementation, and enforcement (Gahr, 1965). The fact is, however, stream standards were required which in turn shaped the structure of water pollution control agencies in the states, as will be seen in Colorado.

Similar to previous Acts, the operation of the 1965 Act is contingent on the system's ability to produce evidence capable of proving or disproving adherence to water quality standards. Proof of violation is inherent to showing that the waters of a stream are, in fact, below the established standard. Again, as before, no statement is made to qualify exactly what evidence is conclusive.

The last point which is absolutely crucial to determining the success or failure of a program is the exclusion of a continuing feedback system. The law requires the states to adopt a plan of implementation and enforcement subject to the approval of the Secretary, but the instrument which supplies this violation information for the effectuation of the Act, explicitly the water quality monitoring system, is excluded. The backbone of the Act is not subject to Federal approval (Water Quality Act of 1965, PL89-234).

There have been additional Acts and executive orders which relate to water pollution control, but none carry the impact of those just reviewed. In addition to Federal action,

Colorado was active in developing legislation for water pollution control.

Colorado Legislation

Colorado has, for a long period of time, dealt with problems relating to water pollution primarily as a result of concern over health (see Colorado Department of Health, 1969 for a general history). Colorado law in the process delegated powers and jurisdiction to a number of entities concerned with water pollution control.

These laws, powers, and jurisdictions are reviewed in detail by Nichols (1972a). Until 1965 Colorado had not been extremely active in water quality management except for the enforcement conference called in 1963 to look at water pollution problems in the South Platte River. A quote from the State Health Department (no date) explains the situation before 1966.

> Until recent years, both state and Federal water pollution control laws were weak, confused and ineffective. States have had water pollution control laws for years, but neither found it economically feasible to prosecute offending industries, nor politically expedient to crack down on polluting municipalities. Cities have applied political pressure against attempts by the states to force abatement.
>
> The authority for water pollution control in Colorado prior to 1966 was vested in several state agencies. The Colorado Department of Health had the authority for standards regarding discharges of human wastes. The State Department of Game, Fish and Parks enforced control of pollution causing damage to fish, spawning areas and aquatic life. The Oil and Gas Commission had the power to control pollution to waters resulting from oil and gas production. The laws gave pollution control powers to

> other state agencies and municipalities over special sources and areas. Water pollution control in Colorado, like that in many other states, suffered from divided authority and hard-to-enforce laws.

The rising crisis of polluted water in the 1950's and 1960's, especially within the South Platte Basin, showed that the State's ability to deal with pollution problems was weak. Population and industry were growing rapidly within the Basin and particularly in the Denver Metropolitan region. The problems of waste disposal were becoming increasingly severe. The criticalness and complexity of the situation demanded a well organized assault on the pollution problem.

On July 18, 1963, Governor John Love of Colorado requested that an enforcement conference be called. The stated purpose of the study was to locate the sources of pollution having an adverse effect upon water quality; determine the physical, chemical and biological responses of the river to pollution; evaluate the previously located sources of pollution with respect to conditions in the river; compute the waste load reductions necessary to obtain desired water quality; and recommend water quality control measures needed to effect the desired waste load reduction.

Following the 1963 conference, a two and one-half year study was undertaken on the water pollution problems of the South Platte River Basin. The second session of the conference, on April 27 and 28, 1966, was called to consider the results of the investigations. A series of reports revealed the nature of water pollution in the Basin with

great emphasis placed on problems of the Denver Metropolitan Area. The results of the study bore out Governor Love's concern for calling the conference in 1963.

Overall, the data for the Denver Metropolitan area showed poor quality sewage treatment. Plants were frequently operating at capacity or were overloaded. Treatment was generally inefficient and provided low removal of BOD and TSS concentrations. High tonnages of these wastes were being dumped into receiving streams daily.

The interim period between the South Platte Conferences saw the Federal 1965 Water Quality Act come into existance. Colorado adopted legislation to comply with Federal law on March 1, 1966, just prior to the convening of the Second Conference in April. Because of the South Platte Conferences, Colorado had the strong advantage of an outstanding, detailed inventory and report of water quality conditions in the South Platte River. However, these reports were not utilized by Colorado in establishing stream standards (Evans, 1972); however, they were utilized primarily for establishing abatement schedules for polluters in the South Platte River Basin.

As was mentioned above, Colorado adopted legislation March 1, 1966, according to the Federal requirement for a plan of implementation and enforcement by the state. Within the new Colorado legislation was contained the establishment of the administrative body, the Water Pollution Control Commission. The first meeting of the Commission was held

in conjunction with the April session of the Conference. In light of this fact, the conferees agreed to meet on November 10, 1966, to allow the new commission sufficient time to study and evaluate the Federal report, and develop a program for implementation of remedial measures and a time schedule in compliance with Federal requirements (FWPCA, 1966bb).

The technical report presented to the conferees by the FWPCA's South Platte River Basin Project contained both general and specific recommendations for pollution abatement action, including appropriate time schedules for all major waste sources in the Denver Metropolitan Area, as well as for feedlot operations and the sugar beet industry throughout the basin (FWPCA, 1966bb).

The water quality objectives recommended by the South Platte River Basin Project, in essence, were those objectives later adopted by the Colorado Water Pollution Control Commission in January of 1967. The State's position at the Conference was stated by Dr. Roy Cleere, the Executive Director of the State Department of Health. He indicated his pleasure with the progress being made in controlling pollution in the South Platte Basin. He felt the most significant step was the installation of the Denver Metro Sewage Plant which went into operation October 17, 1966. At that time he felt the Denver Area was receiving adequate treatment for the first time.

At this point, a chronology of events may help clarify the overlapping interactions of the South Platte Conferences

and Federal and Colorado legislation (Table 1). Also, from the discussions of Federal legislation and the enforcement conferences, it can be seen that the Federal Government played an integral role in the formation of Colorado's Water Pollution Control program. Now to look at this program.

The Colorado Water Pollution Control Act of 1966 provided for "The Prevention, Abatement, and Control of the Pollution of the Waters of the State." The 1966 Act was amended in 1967 to allow setting effluent standards when stream standards were reached or exceeded but did not specify how violations were to be detected (Colorado Water Pollution Control Act as Amended in 1967, CRS 1963).

The Water Pollution Control Commission was established as the administrative enforcement and policy making body, with the following membership:

1. Representative of State Board of Health;
2. Representative of Game, Fish and Parks Commission;
3. Representative of Water Conservation Board;
4. Natural Resources Coordinator (permanent chairman); and
5. Seven (7) citizens (one from industry, one from agriculture, one from local government and four at large) appointed by the Governor.

Colorado's Water Pollution Control Program

As mentioned above, Colorado has, over the past decade, developed a legal basis for control of water pollution. The purpose of this section will be to describe the manner in which the directives of the legislature have been fulfilled.

Table 1

Chronology of Pollution Events

Date		
Oct 2, 1965	Water Quality Act of 1965 (Federal)	Required states to adopt criteria and plans of implementation and enforcement by June 30, 1967
Mar 1, 1966	Water Pollution Control Act of 1966 (State)	Met Federal requirements of 1965 Act and established the Water Pollution Control Div
Apr 27 & 28, 1966	Second Session South Platte Conference (Federal-State)	Reports findings from the 2½ years of Federal-State investigations
May 10, 1966	Reorganization Plan No. 2 of 1966 (Federal)	Transferred the FWPCA from HEW to the Dept of Interior
Nov 10, 1966	Second Session South Platte Conferences Reconvened (Federal-State)	Reviewed recommendations in April to develop a program for implementation of remedial measures and time schedules
Mar 1, 1967	Effective date of water quality standards for Colorado (State)	Finalizes and puts standards into action legally

Colorado's 1966 Act provides for basically two main aspects of the state's water pollution control organization. These are the Water Pollution Control Commission and the Division of Administration. As described, the Commission has eleven members - four members represent state government agencies and seven are state citizens appointed by the Governor. The Commission is designated as the state water pollution control agency for Colorado for all purposes of the Federal Water Pollution Control Act as amended. The Commission, therefore, not only has duties assigned to it by state law, but it is also required to carry out directives of the Federal law. Federal directives have included the establishment of stream criteria, development of an implementation plan to enforce criteria, initiation of a planning effort, and currently, the consideration of a permit system.

The powers and duties of the Commission as stated in the state law include:

1. Supervision and direction of the Division of Administration and the director of the Division as the provisions of the Act are administered and enforced by the Division.
2. To adopt a comprehensive program for the prevention, control, and abatement of pollution of the waters of the state.
3. To accept and to supervise the administration of loans and grants.

4. To employ a technical secretary and to delegate to such technical secretary such duties and responsibilities as it may deem necessary.
5. To cause samples to be taken from the waters of the state periodically and in a logical geographical manner so as to advise the Commission of the water quality standard of the waters of the state.
6. Whenever a sample collected at the direction of the Commission proves to be below the water quality standard set for that water, then the Commission shall determine the source of the pollution and if more than one source is responsible, determine all sources of the pollution so that one hundred percent of the sources responsible for the pollution can be determined.
7. Hold such hearings as it deems necessary for the enforcement of the Act.

The Commission is also required to hold quarterly meetings, but in actual practice it meets once-a-month. During these one-day meetings, the Commission discharges its duties and provides supervision and guidance to the Division of Administration. A point of clarification is needed here to distinguish between the Division of Administation (DOA) and the Water Pollution Control Division (WPCD).

The relation of WPCD to the DOA is not made clear in the law. Article 66-28 dealing with water pollution control makes no specifications of a particular Division under the

DOA; therefore, it must be assumed from actual practice that the WPCD is the agent of the DOA in charge of water pollution control affairs.

Powers and Duties of Water Pollution Control Division

While the activities and duties of the Commission are fairly clear in the law, the structure and functional duties assigned to the Division of Administration (Water Pollution Control Division) are, to a large extent, left to the Commission's desires and the existing nature of the Department of Health where the Division is housed. The law does spell out some duties and powers of the Division. These include:

1. To develop a comprehensive program for the prevention, control, and abatement of pollution of the waters of the state.
2. To administer loans and grants.
3. To take such action in accordance with rules and orders promulgated by the Commission as may be necessary to prevent, abate, and control pollution.
4. To take such samples of water as deemed necessary to determine the amount of pollution of any of the waters of the state.
5. To recommend stream classifications.

Organizational Structure of WPCD

As a result of the law, the Commission's supervision, and the Department of Health's nature, an organizational structure and functional assignments have been developed. These

assignments and the structure serve to guide the Division in its everyday activities. The organizational chart for the Division is shown in Figure 1.

The Division of Administration is shown to be responsible to the Water Pollution Control Commission, which in turn is basically appointed by the Governor. The Division of Administration is a division of the Colorado Department of Health and therefore, the administrative services of the department handle the budgetary and personnel activities of the Division. Budget requests to the Legislature are a part of the Department of Health's requests and once obtained, the funds are channeled through the Department's money management personnel. The Division, as a part of the Health Department, is also under the same personnel management scheme as the Department. The same job classifications and pay scales that apply to the Department also apply to the Division.

The Division has the laboratory analyses of their water samples run in the Department's laboratories. In return, the Division pays the salaries of several laboratory personnel. The Division is housed in the Department of Health's building in Denver and presently shares district engineers with the Department. Each district engineer is performing water pollution control duties and public health duties. Some of the engineers are employed by the Division of Water Pollution Control, while others are employed by other divisions in the Department. The state is currently divided into 12 districts and three districts have engineers responsible to the Water Pollution Control Division (WPCD).

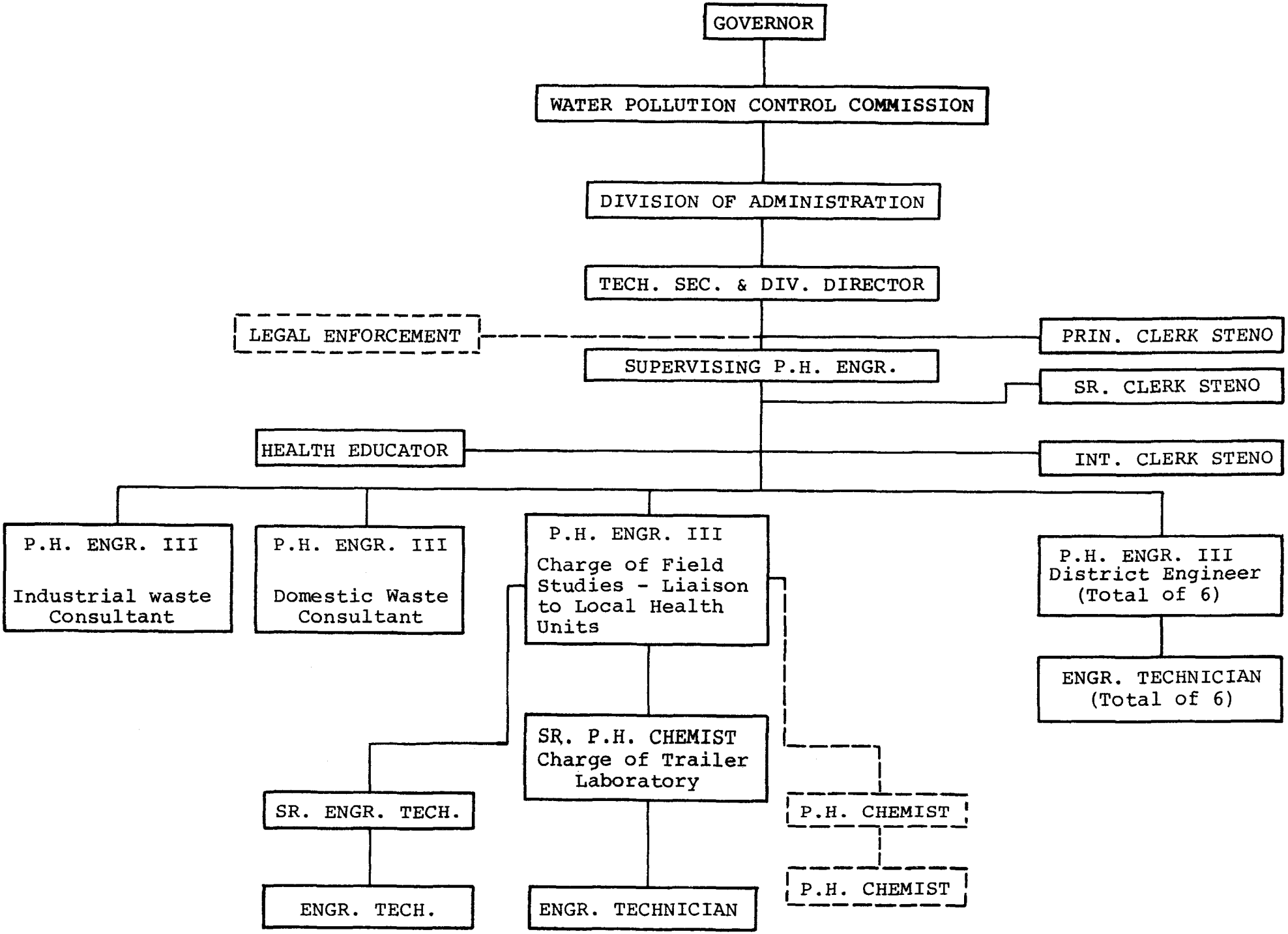

Figure 1. Water Pollution Control Division organization chart.

Currently, the WPCD does not have a full-time attorney. Whenever legal services are needed, an attorney is obtained on a part-time basis from the Attorney General's office. The WPCD, although not shown on the organizational chart, is in the process of obtaining engineering planners in order to meet the federal requirements of a regional plan for each construction grant application. The planners will work in the state planning office and with the WPCD.

Much of the public relations work of the WPCD is handled by the Department of Health. This also includes educational activities in the area of water pollution control.

The technical secretary to the Commission and the director of the WPCD are titles currently held by one man. This person, therefore, works for both the Commission and the Department of Health.

Functional Organization of WPCD

Beyond the organization of Colorado's water pollution control efforts are the actual activities required to satisfy the objectives of the law. In general terms, the Commission establishes policy and supervises the total water pollution control effort while the WPCD primarily administers the overall effort. The WPCD administers loans and grants, while the Commission accepts and supervises. The WPCD is to develop comprehensive water pollution control programs, and the Commission is to adopt the program. The Commission has the authority to adopt water quality standards, and the WPCD is to administer the standards. The list could go on, but the

above three examples illustrate the point. The major duties of the Commission and WPCD were outlined earlier.

For purposes of further discussion of the results of administrative activities needed to satisfy legislative goals, the list of objectives developed by Ward (1971) will be used. He suggested that the objectives of a state water pollution control agency could be broken down into seven categories. These are planning, research, and aid programs, which can be associated with preventing water pollution; technical assistance, regulation, and legal enforcement, which can be grouped under abatement; and the seventh objective is data collection and dissemination, which is basically a support activity to the first six.

Colorado has no research effort and is just beginning a major emphasis upon planning. Aid programs have been pursued by the WPCD in a quite successful manner. Technical assistance is a description of work that the agency does with respect to the installation and inspection of sewage treatment facilities, site approvals, training of sewage treatment plant operators and the technical recommendations associated with eliminating stream standard violations. Regulation and legal enforcement are tied together in that, if through regulation you cannot maintain stream standards, then legal enforcement must be utilized.

Regulation or "enforcement" of stream standards in Colorado involves the following process. When the WPCD or a county health department finds a violation of stream standards,

the first step is to endeavor to eliminate the alleged violations by "conference, conciliation, and persuasion." At this point, the WPCD utilizes much of the available technical assistance. If this tactic fails within a reasonable amount of time, a cease and desist order is issued by the Commission stating the problem and the time by which the problem must be corrected. If the violator so chooses, he may request a hearing on the order and the order is then stayed until the hearing is held. The results of the hearing can be either to withdraw the order or to uphold the order. If the order is upheld, the violator will then enter district court if he continues to violate stream standards, as the Commission will cause the district court to issue an injunction or restraining order against the violator. After a cease and desist order has been upheld and is not subject to a stay pending judicial review, the violator is subject to a fine of $2500 per day of continued violation.

Data collection, processing, and dissemination is a support activity of the first six objectives. This activity is crucial to the successful attainment of the other objectives in that water quality management decisions must have a sound base. The development of this data base goes much further than the actual collection. Data processing includes screening, verifying, interpreting, indexing, storing and retrieving data. Beyond data processing, however, there must be a logical and rational manner of data utilization. Ward (1971a) describes this use of data as the

action initiation step. This includes the generation of action need reports based on the data, inventory and data summary reports, special reports such as annual reports and water quality index reports, and public relation reports. All of these serve to create action from the data base and at the same time provide a basis for decision making. This, in turn, leads to the attainment of established legislative goals.

Stream Classification

Once Colorado had established (in conformance with Federal laws) its legislative and administrative base for water pollution control, it had to satisfy the additional Federal requirement of establishing stream criteria and a plan of enforcement. This constituted the first major administrative undertaking by the Water Pollution Control Commission.

The establishment of water quality criteria and a plan of implementation had to be accomplished by June 30, 1967 in order to meet the Congressional deadline. The Commission, headed initially by Richard Eckles, considered testimony of 3,000 pages produced by 227 witnesses at classification hearings to determine stream standards. For clarity, streams and water bodies were divided into two groups and assigned classifications according to their use and condition. Group I described standards basic to all waters of Colorado. Group II established specific chemical criteria for the following uses (Rocky Mountain News, 1967):

1. Public Water Supply
2. Recreation Waters
    a. Fish and Wildlife
    b. Body Contact Sports
3. Industrial Water Supply
4. Agricultural Water Supply

These criteria are the basis upon which abatement schedules were then formulated. Abatement dates were set by the Department of Public Health by letters of request to known polluters. If no response was received, a second letter was mailed to request a proposed abatement schedule from the polluter. As a final step, the Health Department assigned an abatement date (Rozich, 1971a).

In an effort to trace violators of the standards, 70 surveillance stations were established throughout the state.

On June 12, 1967, the Commission arrived at specific classifications for the streams and tributaries in every basin throughout Colorado. Eckles said the Commission attempted to provide for multiple use, and in general classified the South Platte as follows (Denver Post, 1967a).

1. Public water supply and cold water fishery from its source to Waterton;
2. Public water supply and warm water fisheries to Englewood's Union Avenue treatment plant; and
3. Industrial and agricultural use from there to to Nebraska State Line.

Colorado is one of the few states to meet the Federal deadline of setting water quality standards.

Standards Enforcement

The stream standards requirement necessitated an enforcement and implementation procedure. As pointed out in an earlier section, no intent or direction was set forth in the Federal legislation to act beyond establishing remedial actions. There is no specific intent of monitoring the progress of the implementation program in any of the Federal legislation. This left the Colorado administrative structure for water pollution control with the responsibility of establishing procedures by which the standards could be enforced. The next section devles into an evaluation of the established enforcement system effectiveness and into problems associated with the development of an enforcement program for water pollution control.

In summary, Colorado did respond to the Federal requirements and did adopt stream standards with a schedule for implementation. The Water Pollution Control Commission was established as the policy making and enforcement body of the Colorado water pollution control function.

SECTION 3

PROGRAM EVALUATION

Basis of Evaluation

In order to determine if Colorado's water quality management program is accomplishing its legal goals, accurate measurement of stream conditions is essential. Comparison with the applicable quality criteria (stream standards) then provides a basis for evaluation of the effectiveness of the water pollution control strategy. However, before the data can be used for this purpose, its validity or accuracy must be determined. Poor data may result in false conclusions.

For purposes of evaluating Colorado's water quality data, two recent reports will be utilized. Nichols (1972a) attempted to evaluate the historical water quality data to determine what, if any, changes had occurred in water quality in the South Platte River as a result of the 1963-1966 enforcement conferences. After analyzing the data, he concluded that no basis really exists for comparison. The data over the years has been collected by different agencies, at different locations, and for different purposes. Even when the data is collected over a long time span, Nichols notes that over the years, the values do not show a trend. The data is inconclusive. For more information on this analysis, the reader is referred to Nichols (1972a).

As a result of Nichols' work, Ward (1971a) decided that there had to be a method developed by which the value or accuracy of the data could be determined. This would assist a state agency in evaluating its progress in water pollution control, while at the same time providing a sound procedure for designing a better data acquisition (surveillance or monitoring) system. He developed a procedure for evaluating the quality (effectiveness) of data and then applied the procedure to Colorado. This report will now be reviewed briefly in order to draw some conclusions as to the effectiveness of Colorado's currently available data.

Two basic pieces of information must first be delineated before Ward's procedure can be utilized. First, the strategy to be used by an agency with respect to pollution control must be understood. By strategy, it is meant, how much of the agency's total effort is devoted to abatement (technical assistance, enforcement, and regulation) and how much is devoted to prevention (planning, aid program, and research). This information is needed because abatement activities require real time data which reveals extremes or rapid changes in water quality, while prevention activities need data which indicate long-term trends or base levels in water quality. This leads to an evaluation of surveillance systems in two parts; namely, a primary part which provides abatement data, and a secondary part which provides prevention data. This means that when a single surveillance program is evaluated, it must be evaluated for

its ability to supply abatement data and then evaluated a second time to check its ability to supply prevention data. This is the case for Colorado, which currently has one surveillance network supplying both types of data.

The second piece of necessary information is a characterization of all the streams to be monitored in the surveillance system. Characterizing a stream basically involves bringing together all available data on a stream and displaying this data in such a manner that it can be used to identify sampling station locations and the parameters that are crucial to that stream. Both the strategy determination and stream characterization for Colorado are detailed in Ward (1971); therefore, no attempt will be made to repeat them here.

The evaluation of data was initiated on a grab sampling network (which Colorado employs) and then automatic monitoring and remote sensing were evaluated as possible substitutes or additions. Since the stream characterizations have identified the parameters to be measured and the sampling points, the remaining question is how often should the networks (primary and secondary) be sampled. Then, relating cost to sampling frequency and sampling frequency to effectiveness, the sampling frequency can be removed, thereby providing the relationship between cost and effectiveness. Knowing the amount of money devoted to surveillance will then permit an evaluation of the effectiveness of Colorado's water quality data collection system.

Defining effectiveness and relating it to sampling frequency is the heart of this procedure. The effectiveness of sampling frequencies depends on whether rapid quality changes (spills) or base level trends are to be determined; again, a function of agency strategy. For measuring the effectiveness of the primary network data, a relatively simple surveillance network simulation model has been developed by Vanderholm (1972). This is a mathematical model which allows a large variety of conditions to be simulated. The results from the model are intended for use in design and evaluation of actual surveillance systems.

The model operates by generating a series of pollution events (spills) at random times and locations on the stream reach under study. (Colorado conditions were used.) Downstream measurement and dispersion of the pollutant is calculated using the results of Glover (1964). Various combinations of sampling times and location are introduced, and if sampling and spill coincide at a certain point in time and space, detection of the spill is assumed. By testing the various sampling combinations with a large number of random spills, estimates of sampling effectiveness (detections) can be made. See Figure 2 for a graphical representation of effectiveness versus sampling frequency. Effectiveness, as used in this discussion, does not entail location of the spill's origin, merely identification that a spill has occurred.

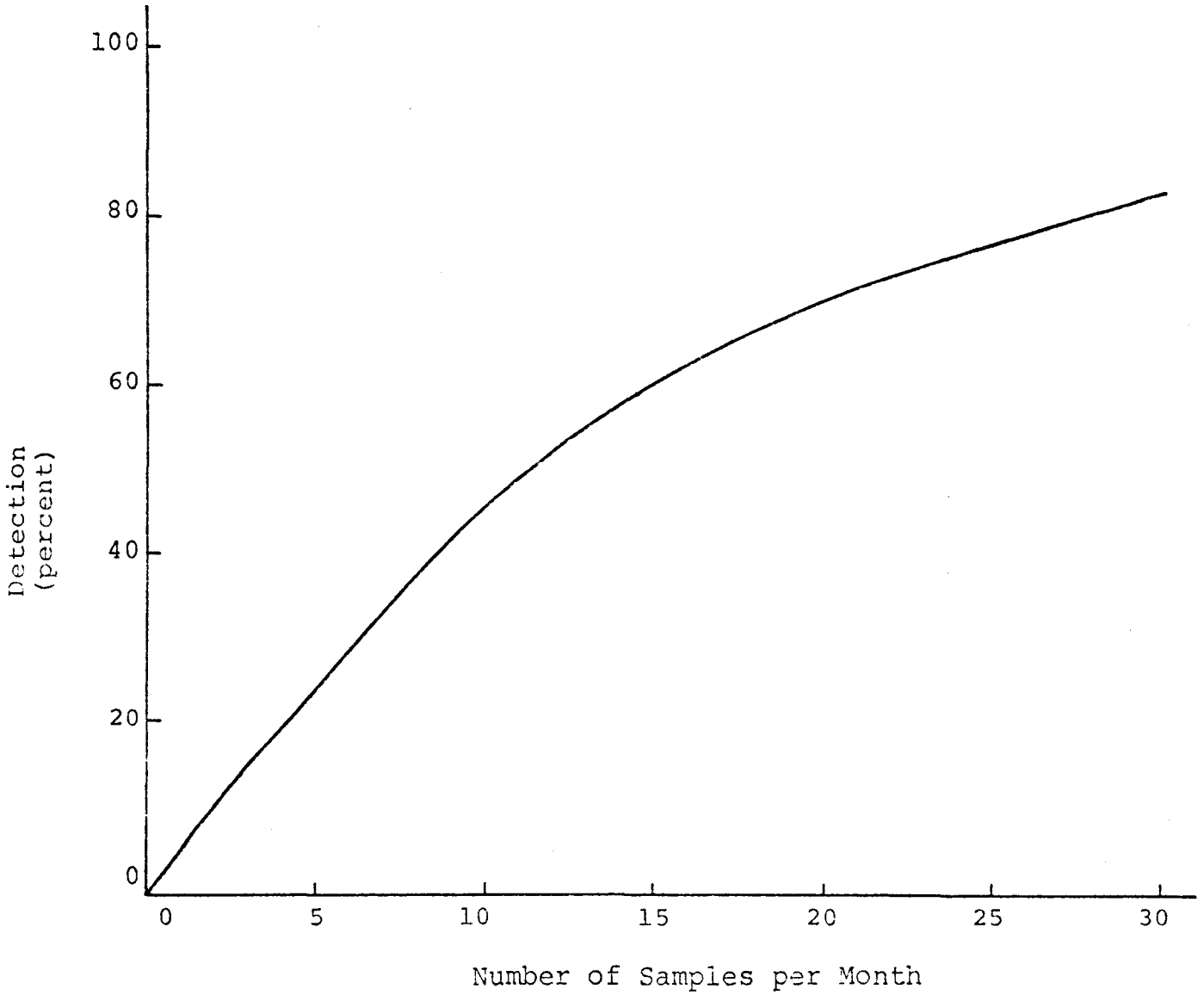

Figure 2. Relationship between sampling frequency and probability of detecting pollution events.

To study base level type data acquisition by grab sampling, a statistical sampling approach was used. For this type of data, the objective is not to detect extremes but rather to obtain representative mean values. Statistical sampling theory contains methods for estimating the number of samples necessary to predict a mean within a given range of the true mean for a known confidence level (Snedecor and Cochran, 1967). This method requires only that some estimate of the variability of the parameter under consideration is available. By then specifying the allowable error (the permissible error between the true mean and sampling mean), the number of samples necessary to assure that the allowable error is not exceeded can be estimated. For the time period in question, the number of samples is related to a sampling frequency at the specified sampling stations. See Vanderholm (1972) for a more detailed description of these models.

The results of the above two analyses are given in Tables 2 and 3. The cost versus sampling frequency information was obtained from the Colorado Water Pollution Control Division (WPCD). This data, when combined with that in Tables 2 and 3, yielded Figures 3 and 4. When the tables and figures refer to primary and secondary surveillance networks, they are referring to the analysis of Colorado's current water quality network to supply abatement or prevention data, respectively.

Table 2. Sampling frequency compared to effectiveness levels for Colorado's primary network.

Effectiveness Level	Total Samples Per Month	Samples Per Station Per Month
10	32	1
20	63	3
30	106	5
40	141	6
50	191	9
60	251	11
70	346	16

Table 3. Number of samples required for various accuracy limits for Colorado's secondary network.

Accuracy Limit (Percentage difference between true and calculated means)	Number of Samples Per Year Per Station
10%	25
20	7
30	4
40	3
50	2
60	1
70	1
80	1
90	1
100	1

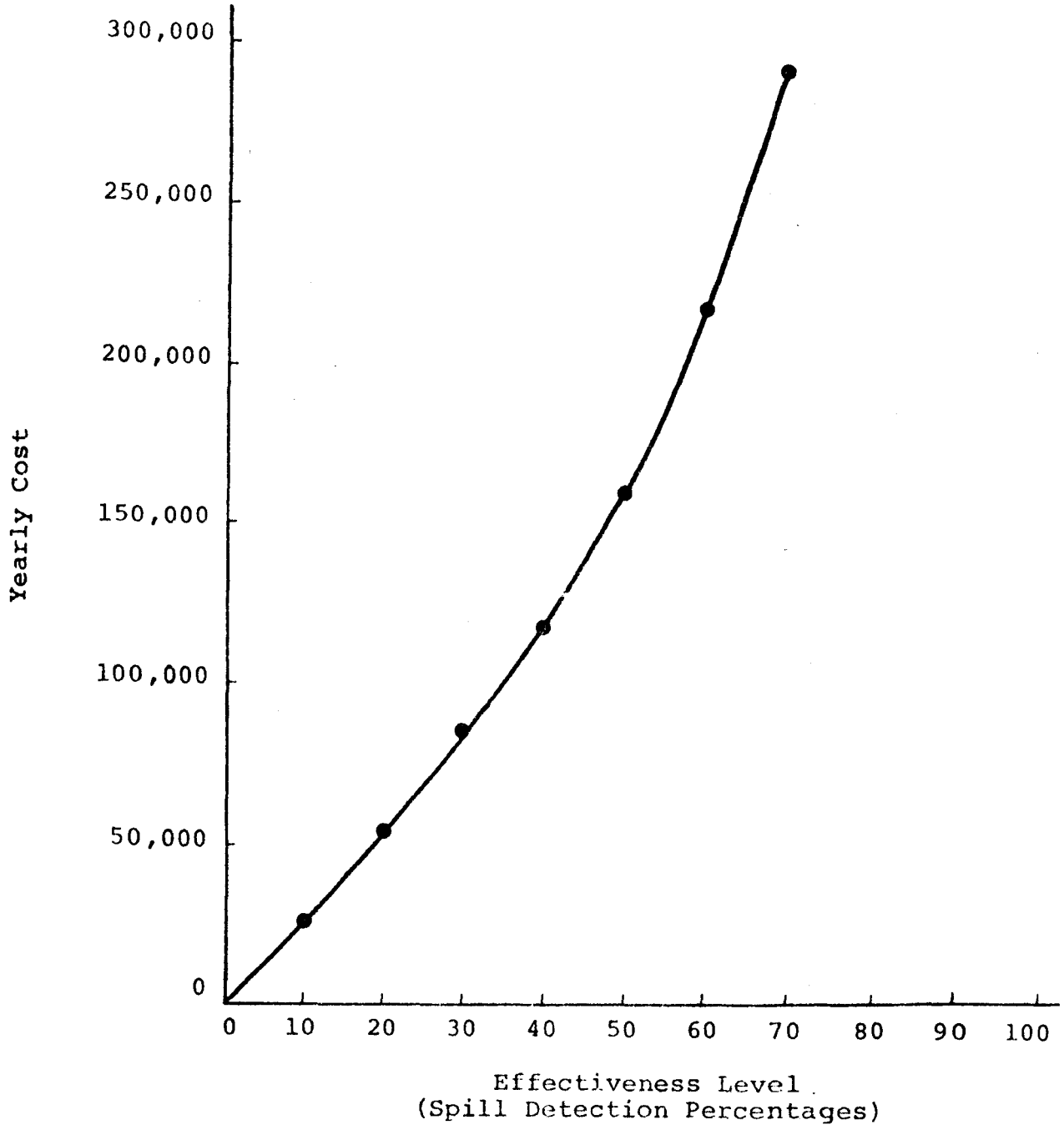

Figure 3. Cost-effectiveness results for the primary network in Colorado for a 0-3 day spill length.

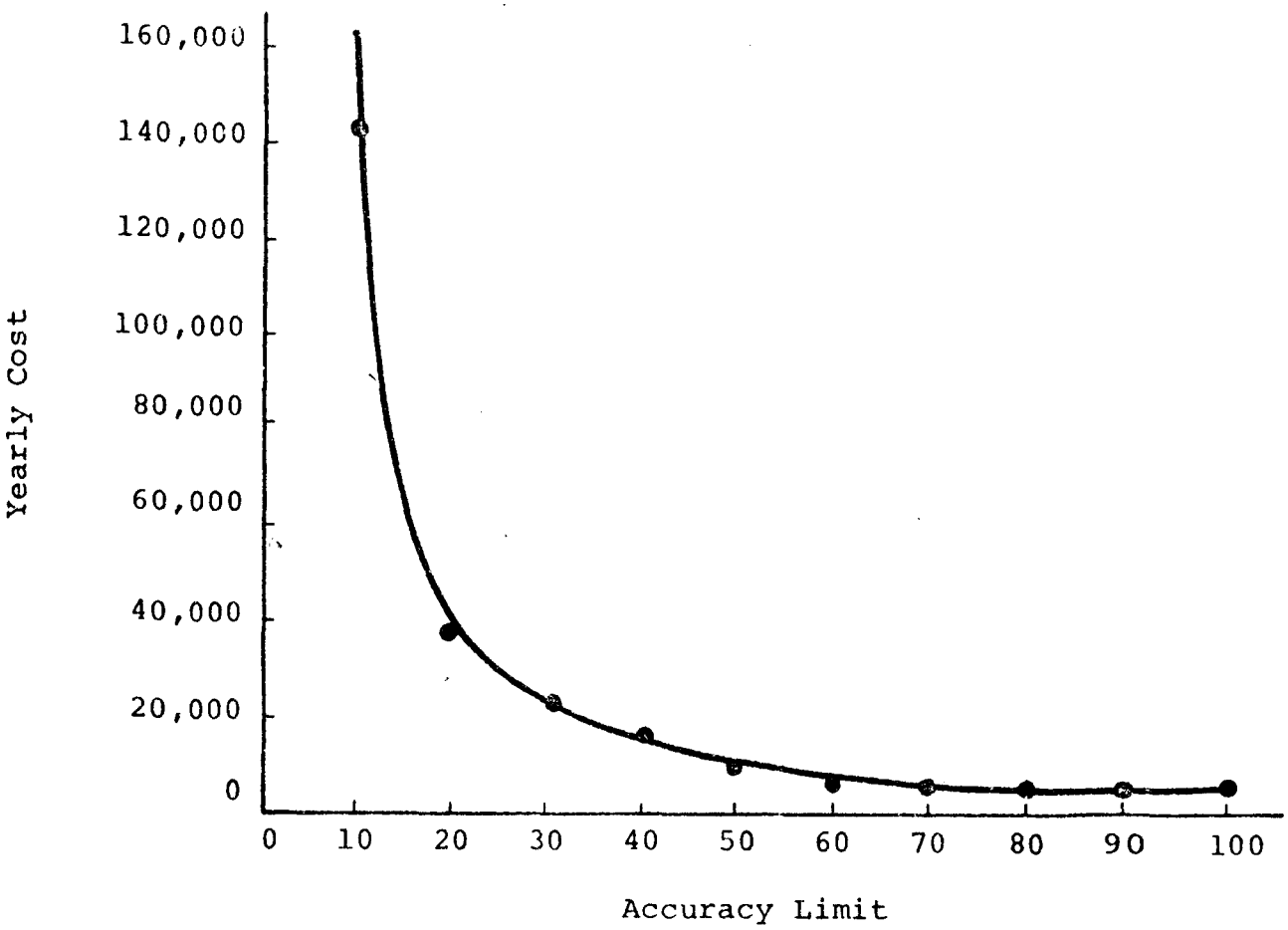

Figure 4. Accuracy limit vs cost for the secondary network in Colorado.

From these results, several conclusions can be made concerning Colorado's surveillance effort. Given that the WPCD collects one sample per month (this may be high), the statistical mean that can be determined from the data is within approximately 17 percent of the true mean. This conclusion is based on the results in Table 3 regarding the secondary network.

Looking at the primary network and considering that all efforts (the one sample per month) are devoted to primary data acquisition, the surveillance network will only detect 10 percent of the rapid quality changes.

The same conclusions could be obtained by observing the figures and relating them to the surveillance budget of the WPCD. In 1971, the WPCD devoted $45,502 to surveillance. Entering each curve (Figures 3 and 4) at this point illustrates the same results as above. If the monies devoted to surveillance were split, Ward's analysis shows that the effectiveness of each network is reduced. For 1972, the WPCD estimated expenditures for surveillance at $166,170. Entering the figures at this point illustrates a huge improvement over 1971. Likewise, the proposed 1973 surveillance budget is $345,136 and this exceeds the ranges on the figures. At this point, grab sampling has reached its limits of effectiveness and other data acquisition technique for the secondary network.

From the results of the foregoing analysis, it is possible to determine the value of the data collected by WPCD.

Basically, the data gives only a general indication of water quality trends and is not able to serve as an effective means for regulation or enforcement of stream standards. Since, as noted earlier, the trends do not indicate any change, it is difficult to conclude from the data whether the water quality in Colorado is improving or degrading. Therefore, it is difficult to conclude anything about the success or failure of the current water pollution control program in Colorado.

Since the data analysis has not yielded the basis necessary to draw conclusions, the next question to ask is why hasn't the data been more conclusive. Answering this question will then permit the development of a surveillance effort which will be geared more toward actively supporting those activites necessary to control water pollution.

Data Utilization

Beyond the value or conclusions of the data, its utilization must be considered. The purpose of data collection by Colorado law is to inform the Water Pollution Control Commission of stream standard violations in order that all sources of pollution may be determined. Since the existing network is not sensitive to more than 10 percent of all spills or rapid quality changes, the network is only informing the Commission of violations that occur in the form of long-term contravention of the stream standards. Since the sampling frequency is low, it is difficult to statistically

state whether any one sample violation is the result of a poor sample or is indicative of a problem. The data is inconclusive. This, therefore, prohibits the monitoring program from being utilized for its intended purpose.

Beyond the Commission, the data would be extremely valuable to district engineers in the execution of their duties. However, the inconclusiveness of the data coupled with a lack of any regular data reports prevents the utilization of data in a meaningful way. The lack of data reports is a function of insufficient personnel directly responsible for a complete data analysis followed by report generation on a regular basis. This precludes any effort to coordinate data collection with its effective use in meeting established water quality goals.

The difficulty in coordination between data collection and achieving water quality goals is not peculiar to Colorado. E. J. Cleary spoke to this point at the National Symposium on Data and Instrumentation for Water Quality Management, July 1970 (Joint Committee on Water Quality Management Data, 1970):

> On one matter there was general agreement. We are not doing as much as we should with the data already in hand. In brief, and in spite of the sophisticated tools now at hand for data storage, reduction, and manipulation, vast amounts of information are being accumulated but seldom subject to interpretation or evaluation. Quite clearly, it appears that the facility for collecting data has not been matched by enthusiasm for employing it for diagnostic purposes.

Colorado, to help remedy this problem, has recently installed

a "STORET" computer terminal at the Water Pollution Control offices (Frank Rozich, 1971b).

Two difficulties are still apparent, however. First, the use of the STORET system does not affect the quality of the original data. Another extract from the National Symposium on Data makes this point (Joint Committee on Water Quality Management Data, 1970):

> Computerized water quality data storage and retrieval, no matter how efficiently accomplished, will not improve the quality of the basic data. Information to be used must be prepared with care and properly labeled.

The specifics of data reliability are discussed in detail in an earlier section. The second difficulty is that use of the computer system still does not mean data can be effectively applied to meeting goals and objectives.

At every level of a water pollution control organization, specific provisions should be made both for analyzing all collected data and providing a systematic application scheme for the data. Specific recommendations will be made later.

An excellent indication of how water quality data is not utilized (be it through inconclusive data or a lack of analysis) is displayed in the Water Pollution Control Division's annual report. This report contains no water quality data. However, a very complete list of activities associated with water quality management is contained in this report. The report (Progress Report on Water Pollution Control in Colorado, Fiscal Year 1970-1971) lists the number of waste treatment plant plans and specifications reviewed, the

number of miles traveled by surveillance personnel, the number of samples collected, the number of special surveys performed, the number of waste treatment plants inspected, the number of waste treatment plant operators taking short courses, etc. No attempt is made to relate these activities to any improvement in the actual water conditions. Therefore, although the administrative sector of the water quality management system is apparently active, there is no way for the public to know if their money is solving the problem of water pollution--the original purpose for having the law enacted.

The problem alluded to is not uncommon. As reported in the Hearings before the Committee on Public Works (Water Pollution Control Legislation, 1971):

> The efficiency of the State criteria systems appears difficult to assess. Not one state applies a specific test to measure the efficiencies of investment in terms of water pollution control. But a pragmatic view of the operation of the systems, one that questions whether a particular investment results in greater pollution abatement benefits than a similar investment elsewhere, will give the answer that chance, not formal priorities, is responsible for any efficiencies resulting from the use of construction grants. All investment may reduce the discharge of untreated waste, but there is no assurance that the critical problem affecting the quality of the water body is attacked.

Data's Relation to Water Quality Laws

Reflection upon Federal and State legal procedures, as described in the previous section, indicates the importance of data collection and its relation to the successful implementation of water quality control laws.

Water quality criteria are related to the stream or other receiving water or portions thereof. The criteria are intended to identify the water uses to be protected and establish limits on pollutants or effects of pollution necessary to provide for such uses. In the Water Quality Act of 1965, the suggested "plan" for implementing and enforcing the water quality criteria was suggested to include sufficient detail to describe the actions to be taken to achieve compliance, a time schedule for compliance, the controls and surveillance for measuring compliance, and the enforcement authority and measures for ensuring compliance. Finally, it was anticipated that after the initial setting of standards (i.e., criteria plus plan), periodic review and revision would be required to take into account changing technology of waste production and waste treatment and advances in knowledge of water quality control. In addition, water quality standards were to be adequate to protect and upgrade water quality in the face of population and industrial growth, urbanization and technological change.

This has not occurred because there is no legal mechanism specified in either Federal or State Laws to relate criteria to standards as defined. In other words, there is no statutory authority or administrative procedure which directs where samples should be taken, or how often, or in what sequence, relative to collecting data for the purpose of identifying pollutants, pin-pointing violations and identifying trends. Furthermore, no guidelines are presented on

how to use the collected data for the accomplishment of the water quality goals of the State. In short, there are no guidelines which outline the administrative mechanics to effectuate standards in Colorado.

All of the previous discussions clearly support the conclusion that evidence (data) is the backbone of a water quality management program and that currently this backbone is quite weak. There is a failure at the Federal level to require and at the state level to adopt, a plan to effectively monitor the true quality of a state's waters on a continuing basis. In addition, there is no specific procedure prescribed in the law whereby the data can be applied to accomplish the purposes of enforcement, or more generally, water quality management.

Examples of Data Implementation Difficulties

The following discussion attempts to provide examples of where the data is not utilized properly. The reasons for this are many fold--poor data, poor data analysis, technical presentations which are not understood by a layman commission, etc. Since there is little or no documentation for these examples other than meeting minutes and newspaper accounts, they must be utilized realizing that facts can become twisted when taken out of context. However, the purpose here is simply to illustrate the problem of data implementation, data use, data analysis, or data interpretation. By so doing, it is hoped that the foregoing technical analysis can be related to real world situations.

Implied in the preceding discussions relating data collection to data use is the strong need for the Commission to rely upon their full-time staff for presenting information upon which decisions can be made. Since the Commission meets only one day a month, and has almost no direct participation in field activities, the staff must provide the necessary data, in one form or another, for the Commission's consideration in making competent decisions.

Difficulties of relating data to implementation have been evident in a number of incidents which have come before the Water Pollution Control Commission. It must be reiterated that the field staff are essentially dealing with the "practical results" side of the problem, while the Commission makes decisions from basically theoretical points of view.

During the September 14, 1971 meeting of the Commission, the acting Director of the San Juan Health Unit for Archuleta, La Plata, and Dolores counties made a plea to the Commission to provide him with guidelines for installation of septic tanks within his three-county jurisdiction. In essence, the Commission and the director agreed that a 1/2-acre criterion for septic tank installation was suitable. Then, at the October 12 meeting, a citizen from this area of jurisdiction appealed to the Commission because he had been refused an installation permit on a site that was 0.43 acres by the San Juan Health Director. But the Commission, on the basis that it "would not hurt much," overruled the acting Director and granted a permit to an undersized plot (Water Pollution Control Commission, 1971c).

In the face of growing population and increasing water use, decisions will more and more have to be made on technical feasibility rather than on opinion, as in this case.

On October 21, 1971 the Commission had a chance to deal with the long standing and publicized problem of Greeley sewage treatment (Denver Post, 1971). The District Engineer for that region had completed a comprehensive engineering study and repeatedly "coerced" Greeley to make appropriate modifications in an attempt to double their 37 percent domestic BOD removal. The Stream Survey Director for the Division had conducted special continuous monitoring with the state's mobile lab to establish Greeley's consistency in its record of poor treatment. In conjunction, a chemist from the air pollution division had conducted a six-month study to determine that an acute odor problem in the area was attributable to the Greeley plant. Evidence (data) had been presented to the Water Pollution Control Commission only as a last resort to force Greeley into dealing with their problem. A cease and desist order was expected. Again, the Commission chose to "further investigate the problem" and assigned a Commission member to investigate the difficulty. The presentations did not convince the Commission that action was necessary (Water Pollution Control Commission, 1971c). Again, technical data was ignored as the basis for administrative actions. At the next meeting, the Commission member supported the reports and action was taken.

In another instance, Empirius Mining Company at Creede reportedly was the source of zinc-mill waste flowing into Willow Creek, which in turn flowed into the Rio Grande River causing a fish kill. Mr. Barry Nehring, Game, Fish and Parks Division, reviewed before the Commission the discovery of a fish kill in the vicinity of the Wasson Ranch, and the detailed investigation that was made to discover the cause. Me. Nehring related, in detail, the series of samples and the times at which they were taken, and the discovery of a broken waste-water conveyance ditch belonging to Empirius Mining. Mr. Nehring documented, in a detailed technical presentation, why he felt Empirius was responsible for the fish kill.

> The Commission asked numerous questions concerning this matter and discussed whether or not a cease and desist order should be issued at this time. The discussion pointed up the deficiencies of the Water Pollution Control Act with respect to these one-time violations. It was also felt that our own staff should conduct an investigation of this situation. A possible solution to this long-standing problem was also discussed and the possibility of removing the old tailings completely suggested as a means of clearing up the problem, and perhaps the U.S. Bureau of Mines could assist with a research or demonstration project. Mr. Smith, Liaison Officer for the Bureau of Mines, was present and stated he would be glad to forward the information to the Salt Lake Metallurgy Lab for their opinion. It was the consensus that a cease and desist order would not be issued at this time and that the U.S. Geological Survey should be contacted and request that this area of Willow Creek should be included in the mine drainage study to be conducted by them in cooperation with the Commission.
>
> Administrative direction - The Technical Secretary was directed to contact USGS and request that this stretch of Willow Creek be included in the mine

> drainage study to be conducted under our joint aggrement. Also, have our own engineers make some corroborative studies of the area (Water Pollution Control Commission, 1971b).

Four months later, and after three public meetings, the Commission took action.

Other examples exist which apparently are indicative of the same difficulty: the Commission failed to act after a "technical presentation" reportedly attributing fish kills to New Jersey Zinc Company at Gilman; the Commission gave favorable action to experimental package sewage treatment plants despite pleadings by local and state health experts that the particular system would not operate properly and would pose a health hazard (Denver Post, 1972).

All these examples reflect in one way or another upon the incapacity of the system to effectively employ technical data as a basis for enforcement and implementation. In every example presented here, a "technical presentation" is made before an essentially lay commission only to be reinvestigated or the field decision overturned. Are the technical presentations weak and non-convincing; is the data analysis poor; or is the data itself poor? The answer includes parts of all three. How can this situation be corrected?

SECTION 4

PROPOSED ALTERNATIVES

Given the situation that effective water pollution control is integrally dependent upon 1) representative collection, and 2) effective application of collected data, and that neither is occurring, what are the alternatives available? Two conceptually simple alternatives will be presented but realizing that there are many specific solutions that could be generated from the two broad concepts.

The first suggested alternative to alleviate the problems could be to alter the present system sufficiently so "perfect data" could be collected to meet legal goals. Processing and utilization of data would additionally be enhanced to attain the intent of the law.

Since technical evidence is legally established as the backbone of enforcement and implementation, the second alternative proposed is to change the legal basis upon which operation of the system is dependent. In other words, change the law so it is not reliant upon identifying polluters from in-stream analysis.

In practice, perhaps a combination of the two general alternatives would provide a more viable system for controlling water pollution than purely one or the other. For the sake of clarity in discussion, however, the ramifications of adopting one or the other of the alternatives separately will be considered.

Alternative I

Obtaining "perfect data" will involve considerable revision of existing surveillance policies. A surveillance system consists of sampling parts of an entity to obtain a picture of the whole. This, if done correctly, involves considerable statistics, mathematics, and water quality expertise. For example, no statistician would sample a population (water quality in Colorado) without first planning the sampling procedures. A data acquisition system must be fully planned by qualified personnel. This implies that a state agency should spend considerable effort in designing its data acquisition system. In this way, much more effectiveness can be gained for less cost.

When planning a water quality data acquisition system for Colorado, care should be taken to consider water quantity. The necessity for coordination of the quantity and quality aspect has long been acknowledged in the water resources field. Water quality, by definition, considers the volume of water in a stream and the waste loading which it carries (Freemen, 1969). Presently, no corresponding flow data is taken for a given quality sample. The necessity for simultaneous samples is imminent.

As emphatically pointed out in the hearings before the Committee on Public Works of the House of Representatives (1971) regarding oversights in existing water pollution control legislation, "the question of 'quality' is inextricably bound up with the question of 'quantity.'"

A means to incorporate the two considerations and alleviate the quality-flow difficulty could be close at hand. The State Engineer is presently working on a scheme to institute a data bank for the quantity records of surface and subsurface flows in Colorado. Incorporation of quality records into such a system could be an acceptable alternative to managing data for both quantity and quality interests. This does not solve the application problem, but would help develop a storage and retrieval system which can be manipulated easily to generate water pollution control action through "action need" reports. These computer reports would spell out very clearly the action needed to remedy a problem noted by a compution analysis of the data.

Many problems associated with managing quality data are also encountered with quantity data. Not unlike quality data, quantity data may take as long as 16 months to be processed from field to print. Techniques to reduce this severe time lag need to be developed. Software which could allow direct transferral of field data to the computer is yet to be effectively developed. The work load accrued by copying data over by hand or punching computer cards by hand are serious limitations.

However, when these mechanical difficluties are overcome, a number of advantages would be gained from a data bank. One great advantage would be the virtually unlimited access to files and an ability to manipulate data. Unlike, "STORET," the computer handling this data would be locally operated within Colorado. Pennsylvania is currently developing

a computer software whereby a state agency can establish a computer assisted information handling system.

Hand-in-hand with combining quantity and quality data into a centralized bank could be the elimination of duplicated site visits. As it now stands, field teams taking quantity data may visit the same station as teams taking quality data. A single team could record both aspects simultaneously in one visit. The value of both kinds of data would be enhanced by taking simultaneous data measurements, as well as eliminating duplication of efforts. Flow and quality measurements would at last be taken together.

Before such a system could be innovated, however, careful consideration and much planning would have to be given to identification, updating and retrieval techniques, as well as their associated costs (Longenbaugh, 1971).

The WPCD should work with the State Engineer in developing a dual system of data collection and retrieval. Many of the needs for program evaluation and planning could then be met in conjunction with the revised routine monitoring system. As an immediate addition to the monitoring system, it is suggested that arrangements for corresponding flow data be made on major streams.

Available Resources (Physical)

Unfortunately, water pollution control has traditionally taken low priority in appropriations. Schools, highways, parks and recreation facilities have always superceded the

necessity of regard for the environment. This low priority on the funding list has generated a score of poorly maintained, inadequate treatment facilities coupled with equally poor attraction of qualified operational staff. All new plans and facilities for abatement must, for the most part, begin with renovation of institutions and facilities alike. In short, all abatement programs must be designed to utilize data, funds, manpower and inherited facilities to their optimum combination to achieve a maximum level of pollution abatement. Ward (1971a) has shown that with Colorado's present dollar input to water pollution control, low level results should be expected.

The Commission, in conjunction with the reorganized monitoring system and system of intense special studies, should direct a systematic compilation of problem areas to be made from special studies and enforcement proceedings. In this fashion, specific justification for budget requests could be made to the Legislature. Vague requests for additional funding could be replaced with specific, factually backed data.

Waste Treatment Plant Efficiency Data

Often the concept of operational abilities and efficiencies is, to some degree, glossed over in the consideration of stream standards enforcement. Meeting certain effluent standards established by law is primarily dependent upon two features: the actual physical ability of the plant to reduce pollutants to a specified level, and the

plant operator's ability to use the existing facilities to achieve the greatest pollution reduction.

The Progress Report of the Colorado Department of Health listed those communities which now have at least secondary treatment. In addition, the Department of Health reported the number of individuals who successfully completed waste treatment operator's courses in local colleges and universities in the past year. Neither of these facts are related to actual improved water quality conditions.

Currently, Division District Engineers perform routine inspection of municipal and industrial waste water treatment plants to certify that the facilities are in proper repair and operation to insure plant capability to meet the State's 80 percent BOD requirement (Colorado Department of Health, 1971b). The argument for actual results is the same here as for listing secondary treatment facilities: training increases the probability of desirable results but in no way measures actual results.

Current efforts to work toward minimal secondary treatment facilities and programs to certify professional treatment operators are encouraged. In conjunction, however, we recommend the establishment of a standardized measurement mandatory reporting procedure for municipal and industrial treatment facilities which would measure influent and effluent qualities and quantities and constituents. If such an intensive analysis reveals over a reasonable sample time consistently inferior results, a detailed review of plant

plant layout and operator capability should be made. The accomplishment of this measurement procedure could be made an additional duty of the mobile laboratory or the addition of a similar mobile system. In doing this, a solid technical basis for additional funding and/or legal proceedings would be established. The data form could be required for review periodically before the Commission and even presentation to the legislature with a definite system of action alternatives following the presentation. The concept of action alternatives will be discussed in a later section.

The purpose of measuring operational abilities and efficiencies could also be effectively accomplished by the instigation of mandatory sewage treatment reports. Such a system would of course depend on legal feasibility. This system could greatly reduce the need for the Division of Water Pollution Control to "police" treatment facilities, thereby freeing funds and personnel of data collection duties and permitting them the funds and time to act upon data.

Data Utilization Capability

The backbone on the enforcement and implementation system has already been shown to be collection and application of technical data. It's rather difficult to expect, then, that a lay commission which by law is qualified only as interest group representatives could act effectively on matters requiring specialized technical discern.

This difficulty of non-technical policy forming and administrative bodies has been experienced by other states with governing commissions similar to Colorado's. In a study of Connecticut's water pollution program, Theodore H. Focht cites the necessity for changing of the "layman" concept in order to impact the state's program. Their commission, which corresponds to Colorado's Water Pollution Control Commission, is composed of nonsalaried citizens, as is Colorado's. As with Colorado, the responsibilities of the members are added on to their respective professional responsibilities and careers. Parallel with Colorado, these commission members, who only meet once a month, must, through necessity, rely heavily on the small Division of Water Pollution Control's staff of only about twenty. Focht suggests that because of the attention water pollution has received, and the magnitude of the state's problem, a full time paid commission is warranted (Focht, 1969).

In addition, the necessity for competent technical staff to back up the Commission and carry out its directives would play a vital role in the system's increased effectiveness.

Just as there is a difficulty among the Commission members to interpret technical data, depicted by the foregoing examples, so there is a parallel difficulty on the part of the field staff to effectively present the data in a manner which communicates the intent of the field findings. The field staff is required by civil service examination to be capable of certain technical skills, but in no way are they required to be

particularly capable of communicating their technical findings. For the most part, field staff must dress and talk the part which can get their job done. Their duties might range from wasing a stream to sampling a sewer effluent, to appearing before a local political or professional group.

When a problem occurs in their district which commands a presentation to the Commission, they must immediately "change character" and deliver an elegant convincing presentation which portrays the technical data in such a manner that communicates their findings and interpretations. To expect such a presentation from a man who is something entirely different 98 percent of his time is to count him an exceptionally gifted man indeed.

Improving Communication Abilities

What then is the root problem of the system's failure? If the Commission has the desire to make valid meaningful decisions and the field staff have the expertise to devise descriptive monitoring schemes, the shortcoming then may simply be an inability to communicate.

Examination of other state programs lends support to this exact allegation. The Water Newsletter (1972) presents the following article entitled "Weary Water Men."

> Florida Conservation Digest reports the following as part of a resolution passed by the state's Pollution Control Board: "And Whereas, this Board is also fatigued by the many aforesaid physical scientists who seem unable to match their answers to the Board's questions--such as biologists telling us of the happy fecundity of oysters in hot water but failing to tell the Board that the same hot water has denuded the nearby estuary...And Whereas,

> this Board has no biologist sitting as members and therefore is neither competent nor even desirous to adjudicate the claims of these competing physical scientists, be it therefore resolved: 1. The executive director shall investigate the feasibility of setting up a Biological Section in this Department of which at least one member shall be a qualified marine biologist of good reputation. 2. This Biological Section shall seek the answers to such questions as the Board may ask of it concerning the environmental impact of any proposed construction...

To bridge the apparent communication gap, the recommendation is made that a communications "superman" be added to the water pollution control function. This one person could be from nearly any background but most likely would have training and experience in both technical and communication fields. Whatever the background, this person would have the ability both to understand and interpret the information gathered by field staff and to eloquently and convincingly present his findings to the Commission. The communication function might even be filled by a small team of qualified individuals. The duties of such an individual or individuals could be on a regular basis communicated either by inspection or conversation with field staff and then prepare presentations to the Commission. Overall, through the communication expert the Commission would be working more closely with the field problems, be provided with more competent technical ability and thus formulate more realistic rules, regulations and standards for the improvement of water quality in Colorado.

To insure an active, challenging program for this communication function, duties could include participation in the generation of the regional plans required by the Federal

Government by the end of Fiscal 1973. Funds already allocated by the State Legislature for these planning positions should be augmented to insure the employment of competent, aggressive personnel which could produce an effective planning program of pollution abatement for Colorado. Forethought should also be given to a progressive system of wages and benefits to make the position attractive to individuals capable of creating a caliber of plans complementary to Colorado's high quality-of-life standard.

Intuitively, securing individuals with such exceptional qualifications would not be accomplished with normal civil service pay scales. The authors' opinion is, however, that Colorado could far increase its control over water pollution by delegating $50,000 to the salary of a qualified communicator rather than generating $50,000 worth of general data which has had little value on a routine basis in the past years.

Improving Organizational Structure

Employing a statistician to obtain better information from routine surveillance and employing a person to communicate this information will greatly improve the efficiency of the Water Pollution Control Division. In addition, better use can be made of this water quality information if the organization is structured to take advantage of the improved output. Prevention data should be supplied to prevention activities which are grouped together, likewise

with abatement. The field services which support the prevention and abatement should also be grouped together. Russell Freeman, in a memorandum to the Colorado Water Pollution Control Commission's Executive Committee, proposed an organization scheme that satisfies these needs.

Freeman noted that a key step in effective direction of an organization is the grouping of activities into manageable units. The most commonly employed method is to group functions requiring similar skills. Freeman's proposed functional organization chart is shown in Figure 5.

This chart suggests three principal groupings, roughly following the prevention, abatement, and field services groupings discussed above. Engineering and technical assistance functions (abatement activities) are concerned with providing professional advisory services and exercising control over technical waste water treatment and control process.

Planning and management assistance functions (prevention activities) are those related to development of plans, programs, and policies needed to prevent the occurrence of future problems.

Field services functions are those which deal with collection of information on the existance, causes, and effects of water quality problems, and related activities.

The administrative functions are those related to accounting for the disposition of funds allocated to matching Federal Grants; control over costs of shared personnel and facilities; and control over a decentralized operation.

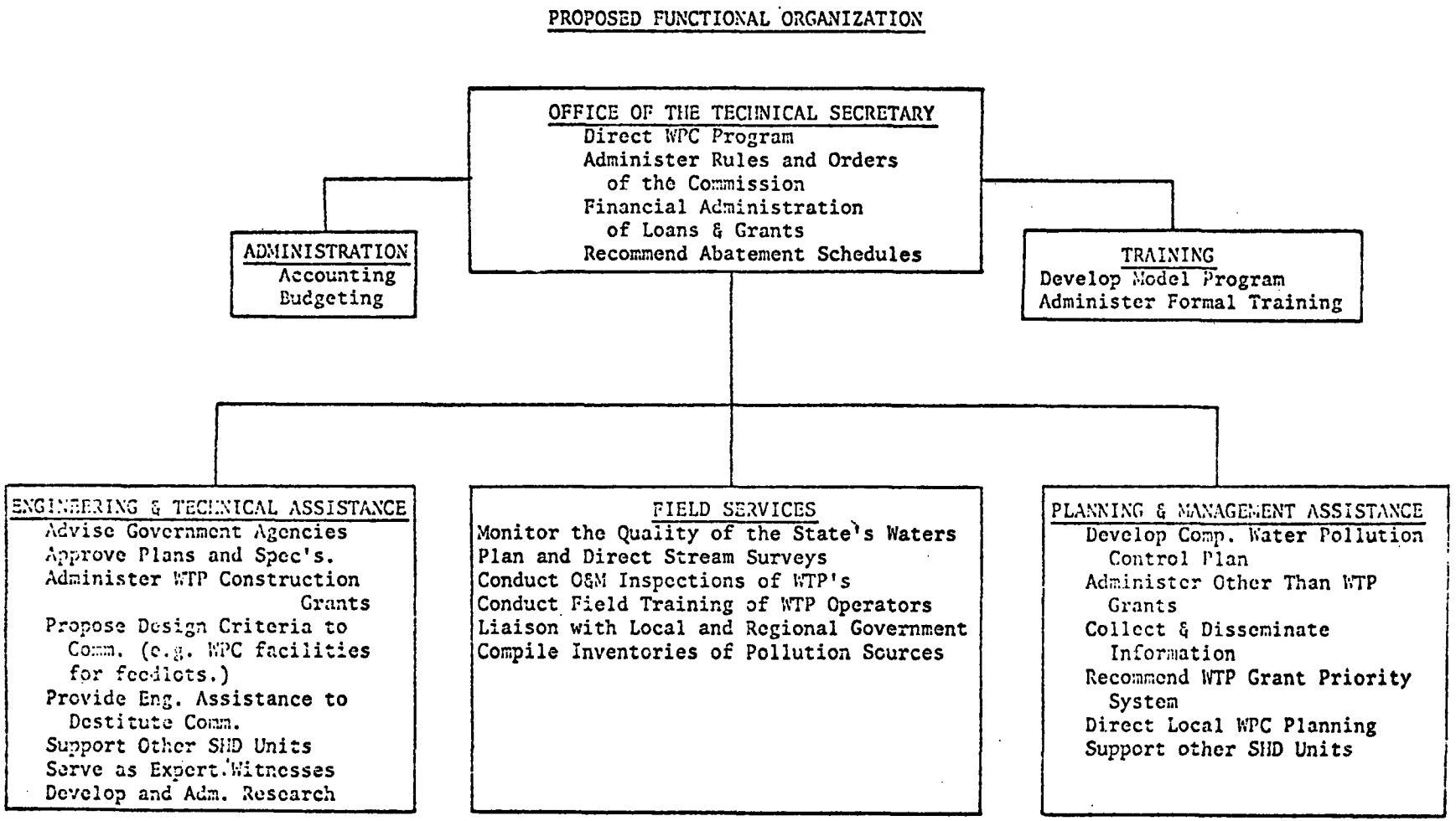

Figure 5. Proposed functional organization.

The proposed organization chart (Figure 6) reflects a suggested change in philosophy as well as organization. Two key elements of the new philosophy are: 1) An increased emphasis on management and control of work (which can logically be carried out by others under the control of orders, regulations, agreements, contracts, etc.); and 2) A decentralization. The decentralization involves delegation of specialized functions (engineering and planning) to technical and planning sections; and the establishment of field officers within the field services section.

Organizational advantages of the proposed structure include:

1. Narrower span of control at the top of the structure. This will relieve an existing problem by providing more time for communication between top managers.
2. More responsibility and increased grade structure for section chiefs, which will mean higher salary and a more competitive recruitment and retention position.
3. Broadening of leadership potential and development of new leaders. This should greatly improve employee morale.
4. Providing a system compatible with that proposed by the Governor.
5. Providing a focal point (field office) which is responsive to problems and needs of local organizations and private citizens.

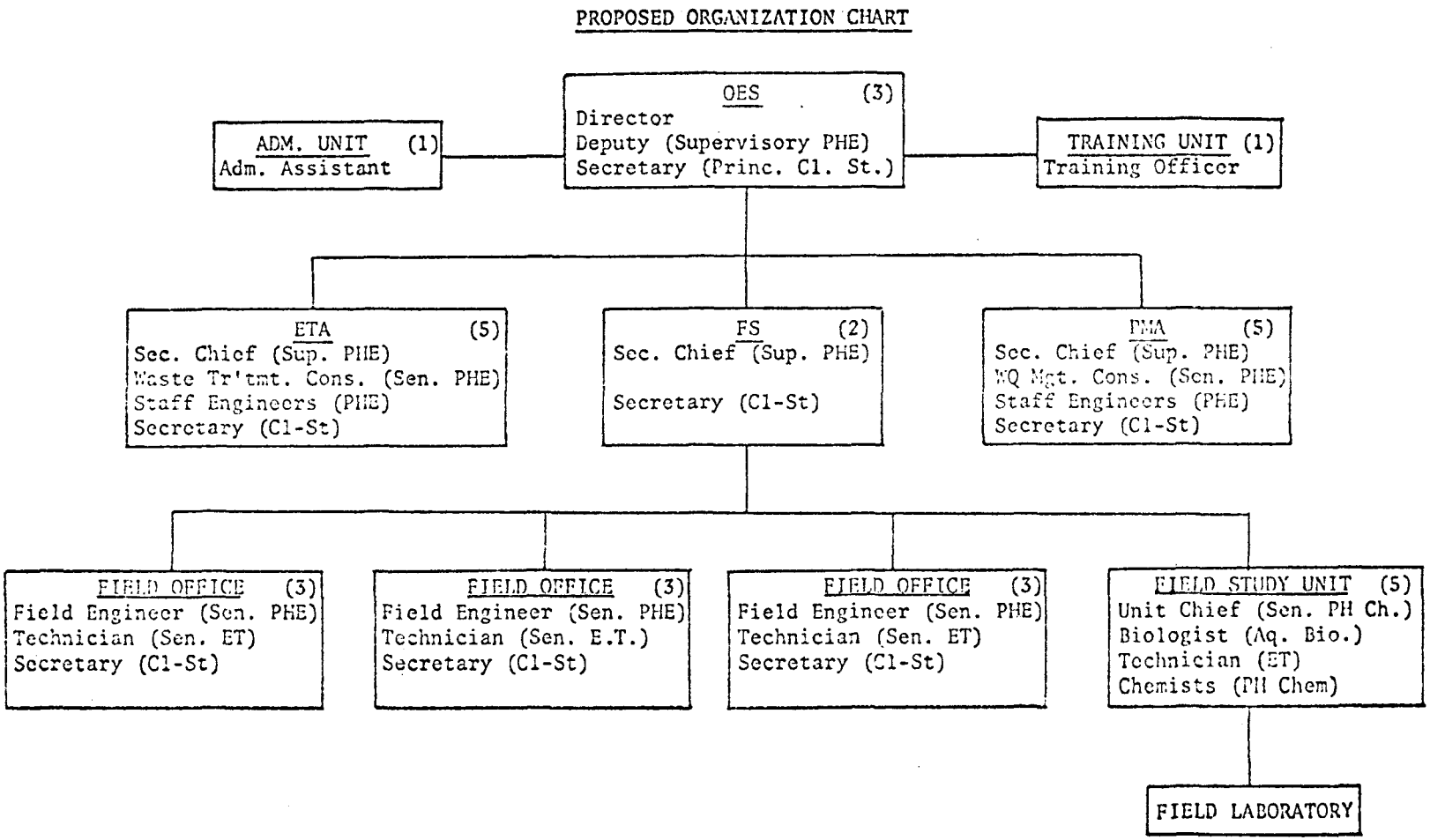

Figure 6. Proposed organization chart.

Alternative II

Colorado's enforcement and implementation program has been centered upon regulation of water pollution control through stream standards to meet legal objectives. The alternative which has been suggested to circumvent the shortcomings of inadequate data collection and application is conceptually to change the basis of law. One of the most popular and effective alternatives available to the stream standards concept is adoption of an out-of-stream regulation system commonly called "effluent standards" or effluent regulation.

The objectives of an effluent standards system, namely enforcement and program evaluation and planning, are primarily the same as for stream standards. The approach, however, especially to the objective of enforcement, is considerably different.

Characteristics of Effluent Standards

Effluent standards carry out a two-fold function for both the water user and the water protection agency. The primary advantage for the water user is that it allows industries and municipalities to strive for an exact objective to meet legal requirements.

Effluent standards offer three advantages for meeting the objectives set forth by law and implemented by the water pollution control agency. First, and perhaps most importantly, such a system of standards allows definite

source identification by virtue of the fact that effluent standards characterize each known source of pollution. This automatically alleviates the difficulty experienced in the current law which requires the impossible task of locating "one hundred percent of the sources responsible for the pollution."

Secondly, effluent standards could identify and regulate amounts and kinds of specific pollutive constituents before they are mixed with other natural and artificial pollutants already present in the receiving waters. This, in a sense, shifts the difficult question of burden of proof from the enforcing agency to the water user himself. The effluent waters of a known source either are within the limits of the law or they are not. No hassle is experienced in first laboriously showing that the polluter in question did actually contribute sufficiently to violate a stream standard.

Third and last, effluent standards regulate and identify efficiencies of treatment operations. Not unlike the present State requirement of 80 percent BOD removal, requirements for efficiencies of all potential pollutants could be set depending on the assimilative capacity of the specific receiving waters. Additionally, not only would effluent standards determine efficiencies but also would determine amounts of pollutants permitted. Clearly, the effect of an 80 percent BOD requirement on receiving waters

would be tremendously greater for a treatment plant processing a hundred million gallons of waste water per day as opposed to a plant processing only ten thousand gallons, given comparable concentrations in both plants.

According to a recent opinion issued by the Attorney General for Colorado, the Water Pollution Control Commission has the authority under existing Colorado law to set effluent standards for all discharges into State waters whether stream standards are being met or not (Hunter, 1971).

Support by Experience

Many states are finding that effluent controls are necessary for efficient water pollution control. A study of Pennsylvania's control system indicates how that state, in many ways, has been aggressively meeting the growing problems of water pollution control.

Pennsylvania performs special surveys from which it develops mathematical models of streams. These models are used to establish the effluent standards. Permits are then issued for plant discharge and the permitted load is described by the following:

1) percent removal limitations;

2) pound removal limitations of constituents; and

3) concentration limitations.

Pennsylvania has traditionally used effluent standards as a means of water pollution control. Their comprehensive attack on water pollution began by making a complete inventory of every waste or pollution outfall in the state. This is continuously updated and added to with the intent of including every water use so that the inventory may eventually be correlated with the use.

Pennsylvania, in summary, has found controlling the effluent is the way to control water pollution. A major part of their effort is put into establishing effluent controls while minimizing their stream surveillance network. Stream standards are converted into effluent standards so that they can attain better and quicker control over water pollution problems. Overall, management considers effluent standards easier to enforce than stream standards (Ward, 1971c).

From a Federal point of view, the system of effluent controls in combination with a permit system has shown great potential effectiveness in controlling water pollution. In a recent study released in March of 1972, entitled Water Pollution Abatement Program: Assessment of Federal and State Enforcement Efforts, the EPA has made a parallel evaluation of effluent controls to Pennsylvania. The study pointed out that, as the law now stands, EPA can take enforcement action only after a water pollution event has occurred -- when a discharge has endangered health and welfare, or has lowered the quality of the water. However, even with testing, it was said, it may be difficult to relate a change in water quality to a specific

municipal or industrial discharge. This point further verifies Ward's and Nichols' findings. The EPA, at the present time, also lacks authority to enforce specific effluent restrictions. The study comments:

> The use of such restrictions would permit the setting of treatment requirements for municipalities and industrial plants before pollution became a problem. Under such a system, enforcement actions would be easier. Showing a failure to meet the established restrictions, rather than showing that a polluter's discharge caused a violation of water quality standards, would be sufficient grounds to start enforcement proceedings.

The present time-table for enforcement also brings difficulties, the study said. Present law does not permit swift action to halt the discharge of pollutants into interstate waters -- even when such discharge endangers health and welfare. There is now a minimum of 32 weeks before EPA can hold a formal hearing, and a minimum 26 week period for abatement.

EPA can move more quickly when water quality standards are violated. However, even in such cases, polluters have 180 days to take, or agree to take, "long overdue abatement action."

While the Refuse Act provisions do permit faster action, through the Department of Justice, EPA has had difficulty in dealing with municipalities discharging sewage in a liquid state and industrial plants discharging wastes into municipal sewers (Comptroller General of the U.S., 1972).

Aspects of Permit Systems

As suggested by the study of the Environmental Protection Agency, a permit system may be an effective means to employ the advantages of the effluent system of control.

An important initial point to be made with regard to adopting permit regulation is that permits in themselves do not improve or enhance water quality. Just as all the water quality data in the world does nothing to improve water quality unless it is applied, so it is for the adoption of a permit system. The point was made in the Hearings before the Committee on Public Works of the House of Representatives Oversight of Existing Program (1971) (hereafter referred to as Oversight Hearings, 1971) that the superimposition of the Corps of Engineers permit system under authority of the 1899 Refuse Act onto California's permit system did not do one single thing to improve water quality, even after hurdling the "morass of bureaucracy" of the Corps' permit system.

The same entrapment may grip Colorado according to a communication with E. B. Pugsley, Chairman of the Effluent Standards Committee for Colorado (Nichols, 1972b).

According to Pugsley, the company who discharges into a navigable stream or tributary thereof makes application to the Corps of Engineers in the appropriate district. The South Platte happens to fall under the jurisdiction of the Omaha office. Copies are then sent to the regional EPA office, as well as the State administrative body. The Division of Water Pollution Control sends the application to the appropriate District Engineer, who may accompany an EPA representative who then determines if the industry in question is in compliance with State standards (which are only those basic standards applicable to waters of the State). When both individuals are

satisfied the operation will reasonably comply with standards, then the application is sent back to the Corps and the EPA. The EPA and the State then have, in essence, a mutual veto power to approve or disapprove the permit. As the gentleman pointed our for California, the whole procedure doesn't do one thing to enhance or improve water quality for Colorado unless Colorado moves to formulate its own procedure of application.

This argument alone is strongly suggestive of the fact that Colorado should formulate her own system, should the permit system be initiated. The Oversight Hearings (1971) make a lucent evaluation of the Corps' adequacy to operate a permit system as stated by the Hon. Joe G. Moore, former Commissioner of the FWPCA:

> While the Corps has an enviable record in navigation, flood control, and water supply project planning, design and construction, I question the advisability of expanding its role in the construction of waste water treatment facilities beyond those needed for military purposes.

Further, Kerry Mulligan, Chairman of the California State Water Resources Control Board, states:

> ...but this is clearly an area in which the Corps has no expertise, no historical expertise, and frankly the inability, in our opinion, to establish one. For instance, they put out a flow chart for this application in its preliminary stage, which I have referred to as a graduate student in Government's attempt to show what you should not do in Government to avoid bureaucracy. It is clearly the most confused piece of work that I have ever seen in my some 15 years' association with Government.

Mr. Moore goes on to point out that "State criteria for priorities should be subject to Federal approval with some means for meaningful review of the State's view."

Since the trend appears to be that the United States Congress may adopt legislation which allows the states freedom to establish their own programs, Colorado should perhaps adopt her own plan applicable particularly to this state itself.

A statement from Wesley E. Gilbertson, Deputy Secretary for Environmental Protection and Regulation, Department of Environmental Resources, Commonwealth of Pennsylvania, suggests strongly that the states be encouraged to use their existing program for administration of permit systems. Further, because under the 1899 Refuse Act no inclusion is made of municipal waste discharges, the Corps' tool may interfere with existing projects within the states. This occurs by virtue of the fact that many industries already installing facilities to meet state pollution standards refuse to continue until they may be assured permits under the Refuse Act.

Should Colorado choose to employ the concept of permits to the objective of reducing and controlling water pollution, it should do so independently of a Federal Government permit system.

Administrative Influences on Possible Legal Changes

Although the system of effluent controls could be applied through the Division of Water Pollution Control under the Department of Health, it may be useful to consider the

possible effects of incorporating this function into a different State agency.

The final report of the Colorado Environmental Commission, released in March 1972, considers the many aspects of environmental control in the categorical sense. The first recommendation made with regard to environmental planning and policy was the following:

> The General Assembly should proceed immediately to review and restructure the environmental decision-making agencies in the State so as to provide strong environmental controls that are complete, effective, and coordinated; and, as an initial step toward that objective, the General Assembly should enact an Environmental Policy Act.

SECTION 5

CONCLUSIONS AND RECOMMENDATIONS

As noted in the introduction, this study is based mostly upon technical considerations. Therefore, the conclusions and recommendations that follow will tend to emphasize the administrative or managerial aspects of utilizing technical results. The findings of this study related to continued use of the present water pollution control system basically urge organizational improvements that will better relate the technical findings to the Commission decision makers. As an alternative to the present system, conclusions and recommendations have been developed for findings related to a different legal system of water pollution control, which appears to offer, from a technical standpoint, certain advantages for more effective enforcement.

In performing an analysis such as this, there are many detailed conclusions that can be presented; however, rather than list all the details, only the principal conclusions and recommendations will be listed. Before citing the conclusions and recommendations, it should again be noted that there is no intention to imply that one system of water pollution control is superior to another. The actual choice of strategy to be used in Colorado is the responsibility of

the Water Pollution Control Commission and the Legislature. The following findings are offered as a guide to effective implementation of either control method.

Findings Under Present System of Water Pollution Control

CONCLUSION ONE: A marked failure to communicate is evident between the field and managerial (technical and policy making) levels of the water pollution control effort. This results in a failure to relate the existing water quality conditions to the governing water pollution control strategies. Two general alternatives are available to remedy the situation: 1) alter the makeup of the Commission (policy makers) so that it possesses the ability to relate to technical information and evidence, or 2) acquire within the water pollution control structure the ability to relate technical information to the Commission. Since the present Commission serves to formulate water pollution control policy, representation of the public is essential. (This relates to the adage that "war is too important to trust to generals," which has a corollary in "water may be too important to leave to water experts.")

RECOMMENDATION: The addition of a communications "superman" to the present structure of water pollution control would bridge the gap between field and managerial capacities. Adequate funds should be made available for the hiring of such a person.

CONCLUSION TWO: There exists a marked lack of specific data available for planning, construction justification, location of monitoring sites, identification of pollution sources, and development of comprehensive abatement programs; all of which, when combined, constitute the elements of developing a state-wide water plan. The mobile lab is a first step toward developing an effective means of collecting such specific data.

RECOMMENDATION: The Water Pollution Control Commission should direct a systematic compilation of special study type reports for every basin and all problem areas. To effectively utilize this data, a full-time salaried data analyst is required who can plan the experimental design for intensive surveys, as well as analyze the resulting data, including the use of mathematical models where necessary.

CONCLUSION THREE: Two types of data are needed for effective routine (as opposed to special studies mentioned above) program evaluation, planning and enforcement.

RECOMMENDATION: The Colorado water pollution control function should adopt two routine monitoring systems (described by Ward, 1971a) to better meet the needs of the agency. The collected data then should be applied through defined courses of action. The organizational structure proposed by Freeman would also help achieve this goal. As a means of supplementing the routine data collection, a public reporting system should be

initiated. This would require the establishment of a phone number to be called any time, from anywhere in Colorado, when the public notices a water quality problem. (Fish kills would be identified quickly, spills noted immediately, etc., at only a small cost to the State.)

CONCLUSION FOUR: Presently, the legal structure requires collection of much data, both routine and special study, for pollution detection and enforcement.

RECOMMENDATION: Colorado should make sufficient funds available to collect the needed data so the established water pollution control strategies can operate properly, or change the law.

CONCLUSION FIVE: A great need exists to coordinate quality and quantity aspects of water management in Colorado.

RECOMMENDATION: The Water Pollution Control Commission should work with the State Engineer to develop simultaneous collection, storage and retrieval of quality and quantity data.

CONCLUSION SIX: The water pollution control structure does not take sufficient data to reveal the effects of program implementation. Program evaluation requires knowledge of specific <u>effects</u> of the agencies' <u>activities</u>.

RECOMMENDATION: In <u>conjunction</u>, standard measurements and a mandatory reporting procedure should be required of all treatment plants to provide sufficient data so

that plant performance may be accurately evaluated. As an adjunct, programs to certify all treatment operators should be implemented to help insure the most efficient operation of each treatment plant.

CONCLUSION SEVEN: Burden of proof presently falls on the water pollution control function, which has neither the resources nor the manpower for effective follow-through.

RECOMMENDATION: The legal basis should be changed so burden of proof does not fall upon the Commission. Enforcement procedures should be altered not to rely upon in-stream measurement. This could be achieved through stream modeling for purposes of relating discharges to stream standards or through the next set of findings.

Findings Under a Changed Legal Basis for Water Pollution Control

CONCLUSION ONE: State studies have shown effluent control to be an effective approach to pollution control for identification, quantification and regulation of pollution.

RECOMMENDATION: Colorado should consider the adoption of effluent controls in conjunction with stream standards control.

CONCLUSION TWO: Permits are, from a technical standpoint, a more effective means of administering effluent standards and allow more rapid enforcement and closer regulation of pollutants.

RECOMMENDATION: Colorado should employ a permit system as a means of administering effluent standards.

CONCLUSION THREE: The present system of permits administered by the Federal Government is administratively cumbersome and has certain shortcomings for improving water quality. The EPA is seeking additional authority in this area.

RECOMMENDATION: Colorado should take the initiative for developing her own permit system for the implementation of effluent control if she chooses to use this form of water quality management.

Environmental Planning

CONCLUSION: The present system of the Water Pollution Control Commission is not capable of the overview necessary to effectively manage the broad spectrum of environmental problems which face Colorado, both presently and in the future.

RECOMMENDATION: Colorado should consider the adoption of an Environmental Control Agency or Environmental Quality Council (of equal caliber to the National Council on Environmental Quality) to provide the overview and centralized management required to meet the growing interrelated problems of environmental control.

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16. Abstract An evaluation of Colorado's present water quality monitoring system has been made, as well as the capability of present institutional programs to anticipate potential pollution problems, and recommendations have been made for alternative pollution enforcement methods. Both Federal and State legislative history pertinent to Colorado water pollution problems have been delineated. Primary emphasis has been given to the South Platte River Basin, because it represents the most severe combination of municipal, industrial, and agricultural pollution problems in Colorado. (Skogerboe - Colorado State University)

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