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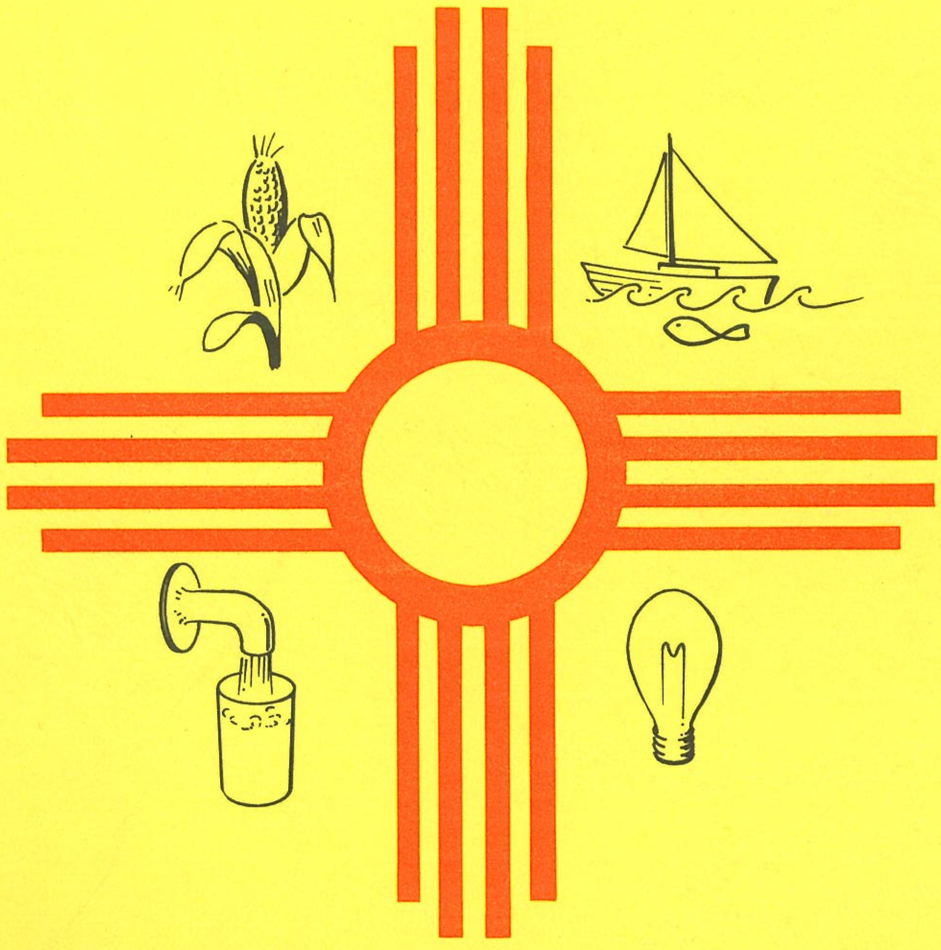
PROCEEDINGS OF THE TWENTY-FIRST ANNUAL NEW MEXICO WATER CONFERENCE

Theme: The Safe Drinking Water Act

April 1, 1976



New Mexico Water Resources Research Institute

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The Safe Drinking Water Act

PROCEEDINGS OF THE

TWENTY-FIRST ANNUAL NEW MEXICO WATER CONFERENCE

New Mexico State University
Las Cruces, New Mexico 88003

April 1, 1976

NOTES

This is a Public Conference. Everyone interested is welcome and encouraged to attend.

There is a $5.00 registration charge for those wishing to attend the Luncheon and to receive a copy of the proceedings.

Twenty-first Annual New Mexico Water Conference

New Mexico State University
P.O. Box 3167
Las Cruces, New Mexico 88003

This is a Public Conference. Everyone Interested is Welcome and Encouraged to Attend.

Twenty-first Annual
New Mexico

WATER CONFERENCE

theme:

THE SAFE DRINKING WATER ACT

APRIL 1, 1976

CLINTON P. ANDERSON BUILDING

New Mexico State University

Las Cruces, New Mexico

PREFACE

The Twenty-first Annual New Mexico Water Conference was held at New Mexico State University on April 1 for the purpose of exchanging information pertaining to water resources.

The success of the Conference hinged upon the generous cooperation of the several state and federal agencies and private individuals represented on the Advisory Committee.

The Institute is indebted to the authors, whose papers made the Conference interesting and worthwhile, to the distinguished persons who presided over the various sessions, and to all those who lent support through their participation.

The information presented at the conference is conveyed to the public through these proceedings. Dean Hernandez and Dr. Barkley based their presentations on a publication they had prepared for the Environmental Improvement Agency on Public Law 93-523. This publication has been reprinted here rather than their actual presentations. All papers are reproduced in the form in which they were received.

Funds required for publication of the Proccedings were provided through registration fees and through the United States Department of the Interior, Office of Water Research and Technology as authorized under the Water Resources Act of 1964, Public Law 88-379.

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TABLE OF CONTENTS

Training Seminar

on

THE NATIONAL SAFE DRINKING WATER ACT

PL 93-523

Prepared for

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION SIX TRAINING PROGRAM

JULY 1976

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TABLE OF CONTENTS

Page

Page

LIST OF TABLES

LIST OF APPENDIX TABLES

GLOSSARY OF TERMS

Act. . . . . means the Public Health Service Act, as amended by the Safe Drinking Water Act, P.L. 93-523.

Administrator. . . . . means the Administrator of the United States Environmental Protection Agency.

Commitment of Federal Financial Assistance . . means a commitment by a department, agency, or instrumentality of the Federal Government, through any authorized agent, to provide financial assistance through a contract, grant, loan guarantee or otherwise. Renewal of a commitment which the issuing agency determines has lapsed shall not constitute a new commitment unless the Regional Administrator determines that the project may have a significant impact upon a designated aquifer and that such impact has not previously been reviewed. The determination of the Federal agency issuing a commitment shall be conclusive with respect to the existence of such commitment.

Community Water System . . . . means a public water system which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

Contaminant. means any physical, chemical, biological, or radiological substance or matter in water.

Effective Date of Regulations (EDR). . . . . . the effective date of regulations is June 24, 1977, which is 18 months following the date (December 24, 1975) the National Interim Primary Drinking Water Regulations were promulgated.

Maximum Contaminant Level (MCL). . . . . means the maximum permissible level of a contaminant in water which is delivered to the free flowing outlet of the ultimate user of a public water system, except in the case of turbidity where the maximum permissible level is measured at the point of entry to the distribution system (contaminants added to the water under circumstances controlled by the user, except those resulting from corrosion of piping and plumbing caused by water quality, are excluded from this definition).

Non-Community Water System . . . . means a public water system that is not a community water system. This type of system is basically one which serves transients. Examples include: hotels, motels, campgrounds, restaurants, etc.

Person . . . . means an individual, corporation, company, association, partnership, State, or municipality.

Primary Drinking Water Regulation. . . . . . . means a regulation which applies to public water systems and specifies contaminants which, in the judgement of EPA, may have an adverse effect on the health of persons and which specifies for each contaminant a maximum level, or for those contaminants for which it is uneconomical or technically not feasible to monitor, a treatment technique which leads to a reduction in the level of the contaminant sufficient to eliminate any adverse health effect.

Public Water System. . . . . means one that provides water piped to the public for human consumption and serves 15 or more service connections (or regularly serves 25 persons); or regularly serves 25 or more persons per day during a period of at least 60 days per year; and includes any collection, treatment, storage, and distribution facilities under control of an operator and used in such a system; and any collection or pretreatment storage facilities used in such a system. There are two types of public water systems: a community water system and a non-community water system.

Regional Administrator . . . . means the Regional Administrator of the United States Environmental Protection Agency.

Recharge Zone. . . . . means the area through which water enters the underground reservoir or aquifer.

Sanitary Survey. . . . . means an on-site review of the water source, facilities, equipment, operation and maintenance of a public water system for the purpose of evaluating the adequacy of such source, facilities, equipment, operation and maintenance for producing and distributing safe drinking water.

Secondary Drinking Water Regulations . . . . . means a regulation which applies to public water systems and which specifies the maximum contaminant levels that are requisite to protect the public welfare, specifically contaminants that may adversely affect the odor or appearance of water and consequently may cause a substantial number of persons served by the public water system providing such water to discontinue its use.

Significant Hazard to Public Health. . . . . . means any level of contaminant which causes or may cause the source of public water supplies to exceed any maximum contaminant level specified in any promulgated National Primary Drinking Water Standard at any point where the water may be used or which may otherwise have a serious adverse effect on the health of persons.

Streamflow Source Zone . . . . means the upstream headwaters area or a river basin where contaminants may enter the streams that replenish an underground reservoir through its recharge zone.

SECTION ONE:

THE SAFE DRINKING WATER ACT

INTRODUCTION

Purpose of the Legislation

President Ford signed the National Safe Drinking Water Act on December 16, 1974. The purpose of the legislation is to assure that water supply systems serving the public meet minimum national standards for the protection of public health. The Act is designed to achieve uniform safety and quality of drinking water in the U.S. by identifying contaminants and establishing maximum acceptable levels. Prior to this Act, the Environmental Protection Agency (EPA) was authorized to prescribe Federal drinking water standards only for water supplies used by interstate carriers. In contrast, this bill permits EPA to establish Federal standards to control the levels of all harmful contaminants in the drinking water supplied by all public water systems. It also establishes a joint Federal-State system for assuring compliance with these standards. The major provisions of the Act are:

1. the establishment of primary regulations for the protection of the public health;
2. the establishment of secondary regulations that are related to taste, odor and appearance of drinking water;
3. the establishment of regulations to protect underground drinking water sources by the control of subsurface injection;
4. the initiation of research on health, economic and technological problems related to drinking water supplies;
5. the initiation of a survey of rural water supplies; and
6. the allocation of funds to states for improving their

drinking water programs through technical assistance, training of personnel and grant support.

Legislative and Regulatory Background

PHS Drinking Water Standards

Under their regulatory powers to prevent the introduction and spread of communicable diseases, the U.S. Public Health Services, then a branch of the Treasury Department, instituted the first national drinking water standards in 1914. These standards applied only to water served on "common carriers" in interstate commerce and covered only bacteriological quality.

The 1914 standards were revised in 1925 to include some chemical and physical criteria and raw water supply criteria. Approved waters were to be from pollution free sources and the supply system to be free from sanitary defects as determined by a sanitary survey.

These standards were revised in 1942 and again in 1946. The major change in the 1942 version was to set the point of sampling for compliance as the free-flowing outlet of the consumer. The 1946 version modified the requirement that a system be free from sanitary defects by acknowledging compliance if an effective program to control and eliminate sanitary defects in the system was maintained. These standards also clarified the responsibility of a water utility for system defects to end at the consumer's tap.

The most current version of the USPHS drinking water standards was adopted in 1962. These standards were still only applicable to watering points for common carriers in interstate commerce. Additional chemical constituents including organic materials were included as were limits for radioactivity. One other noteworthy element was also inserted in the 1962 standards: the requirement that a public water supply system be under the responsible charge of qualified personnel.

A Need For National Standards

By 1970 an effort had started in the Federal government to review and revise the 1962 Drinking Water Standards. In a parallel process in 1971, EPA asked the National Academy of Sciences-National Academy of Engineering to revise the 1968 Water Quality Criteria. One of the six panels that the Academies appointed was on public water supplies and their report is the "Blue Book" entitled Water Quality Criteria 1972.

Congressional interest in achieving better regulatory control of public water supplies was evident about this same time. Congress concluded that the existing legislative authority was inadequate to assure that the water supplied to the public was safe to drink. The Public Health Service Act authorized regulations necessary to prevent the introduction, transmission and spread of communicable diseases in drinking water. Under Reorganization Plan No. 3 of 1970, the authority to establish and revise drinking water standards for interstate carriers was transferred to the Administrator of the Environmental Protection Agency. This authority was interpreted to permit enforcement of standards only with respect to contaminants which might cause or carry a communicable disease. Standards for contaminants which could cause chemical poisoning or other non-communicable diseases were held not to be enforceable.

There were provisions in Federal law to protect members of the public who are not traveling on interstate conveyances from being supplied with drinking water which may cause communicable or noncommunicable illness, although it could be argued that existing authority under the Public Health Service Act could have been utilized in a more expansive way to deal with part of the problem of unsafe drinking water.

An EPA survey in the late 1960's of public water supplies showed the following:

1. eleven percent of the samples drawn from 94 systems using surface waters as a source of supply exceeded the recommended organic chemical limit of 200 parts per billion;

2. fifty-six percent of the systems evidenced physical deficiencies including poorly protected groundwater sources, inadequate disinfection capacity, inadequate clarification capacity, or inadequate system pressure;

3. in the eight metropolitan areas studied, the arrangements for providing water service were archaic and inefficient; a majority of the population was served by one or a few large systems, but each metropolitan area also contained small inefficient systems;

4. seventy-seven percent of the plant operators were inadequately trained in fundamental water microbiology; and 46 percent were deficient in chemistry relating to their plant operation;

5. the vast majority of systems were unprotected by programs to prevent cross-connection with sewage or storm drainage pipes, by programs for plumbing inspection on new construction, or by programs for continuing surveillance of public water system operations;

6. seventy-nine percent of the systems were not inspected by State or county authorities in 1968; in 50 percent of the cases, plant officials did not remember when, if ever, a State or local health department had last surveyed the supply; and

7. an insufficient number of bacteriological samples were analyzed for 85 percent of the water systems and 69 percent of the systems did not analyze even half of the numbers required by the PHS Drinking Water Standards.

National concern for the fundamental elements of life--clean air to breathe, safe water to drink--had mounted by 1970. Investigations demonstrated that public confidence in the safety of drinking water supplies might in many instances be misplaced. In the ten-year period 1961-1970, there were 130 outbreaks of disease or poisoning attributed to drinking water. These outbreaks resulted in 46,374 illnesses and 20 deaths. On the average, this represents one reported waterborne outbreak per month with something over 350 persons becoming ill.

A Subcommittee of the 92nd Congress held two sets of hearings on bills relating to protection of the public health through assurance of safe community drinking water supplies, but none of these bills were ordered reported by the full Committee.

On January 3, 1973, the House version of the "Safe Drinking Water Act" was introduced and an Administration bill was presented in March 1973.

Hearings on these bills were held before the Subcommittee on Public Health and Environment and finally, on February 21, 1974, a new bill, H.R. 13002, was introduced by Representatives Rogers, Kyros, Preyer, Symington, Roy, Nelsen, Carter, Hastings, Heinz, Hudnut, Gunter, and Robinson and was ordered reported by the Subcommittee to the Committee on Interstate and Foreign Commerce. On June 20, 1974, the Committee by voice vote ordered reported H.R.13002, as amended. Comparable legislation had been passed by voice vote of the Senate on June 22, 1973.

Congressional Intent

There are some aspects of congressional intent, as recorded in the House of Representatives Report 93-1185 of July 1974, that merit attention. The following quotations are taken from that report. On primary drinking water regulation:

> Primary regulations must specify contaminants which in the judgment of the Administrator may have an adverse effect on the health of persons when found in drinking water. The words used by the Committee were carefully chosen. Because of the essentially preventive purpose of the legislation, the vast number of contaminants which may need to be regulated, and the limited amount of knowledge presently available on the health effects of various contaminants in drinking water, the Committee did not intend to require conclusive proof that any contaminant will cause adverse health effects as a condition for regulation of a suspect contaminant. Rather, all that is required is that the Administrator make a reasoned and plausible judgment that a contaminant may have such an effect. Moreover, the contaminant need not have the adverse effect directly in order for the Administrator to regulate it as a primary contaminant. If it is a precursor to a contaminant which may have such effect or if it may contribute to such effect, the contaminant should be controlled under primary regulations.
>
> It must be noted that more than 12,000 chemical compounds are now being used commercially, not counting additional variants and fractions. About 500 new chemical compounds are added each year. Many of these will find their way into the nation's drinking water supplies. It is, of course, impossible for EPA to regulate each of these contaminants which may be harmful to health on a contaminant-by-contaminant basis. Therefore, the Committee anticipates that the Administrator will establish primary drinking water regulations for some groups of contaminants such as organics and asbestos. The establishment of such group-wide regulations should help to assure that the public health will be protected from currently undiscovered, unidentified or underresearched subgroups or specific contaminants within the group.
>
> ....regulations are needed both for those subgroups and contaminants which are most prevalent in drinking water supplies and also for those which are very hazardous at low concentrations (carcinogens, for example).
>
> Thus, for example, the Committee anticipates that revised national primary drinking water regulations would include regulation of organics as a group and subgroups, such as haloethers,

polycyclin aromatic hydrocarbons, and nitrosamines.

The Committee, of course, anticipates that all contaminants currently subject to interstate carrier drinking water regulations or to recommended standards would be controlled under both interim and revised regulations, unless the Administrator finds that no health threat may be posed by any such contaminant. In addition, all other contaminants which the Administrator judges may have an adverse effect on the health of persons should be regulated as soon as possible.

On setting maximum contaminants levels:

If in the Administrator's judgment, however, it is economically and technologically feasible to monitor for any contaminant (or group or subgroup), he is directed to prescribe a maximum contaminant level for that contaminant. Of course, in this case, the Administrator would be expected to require public water systems to use at least one of the monitoring techniques which he has judged to be feasible.

The recommended maximum contaminant levels are goals which are to be set at levels sufficient to prevent the occurrence of any known or anticipated adverse health effects with an adequate margin of safety. They are to be based on the NAS report, but may differ from the NAS' proposals if the Administrator finds that adequate justification for such differences exists and if such finding is published and explained by the Administrator.

The incorporation of an adequate margin of safety is not to be confused with the anticipation of adverse health effects. Recommended maximum contaminant levels are to be established by a three-step process. First, the known adverse health effects of contaminants are to be compiled. Second, the Administrator must decide whether any adverse effects can be reasonably anticipated, even though not proved to exist. It is at this point that the Administrator must consider the possible impact of synergistic effects, long-term and multi-media exposures, and the existence of more susceptible groups in the population. Finally, the recommended maximum level must be set to prevent the occurrence of any known or anticipated adverse effect. It must include an adequate margin of safety, unless there is no safe threshold for a contaminant. In such a case, the recommended maximum contaminant level should be set at the zero level.

On requiring a treatment technique:

One example of a group of contaminants for which monitoring might be judged to be infeasible would be viruses, which are currently prohibitively expensive to isolate and measure on a routine basis. Therefore, the Committee expects that the

Administrator would prescribe all known treatment techniques for controlling viruses rather than establishing a maximum contaminant level for viruses. A second example might be as follows: where several specific contaminants occur within a general group, the cumulative expense of monitoring for each individual contaminant might similarly lead to a judgment that such contaminants are ones for which treatment technique regulations should be prescribed. Treatment techniques which the Administrator is authorized to prescribe should include appropriate provision for storage and distribution techniques.

On intake water quality standards:

Therefore, it is the intent of the Committee that the Administrator, in prescribing national primary drinking water regulations, assume that intake waters will be sufficiently uncontaminated so that with application of the most effective treatment method(s) a public water system would be able to protect the public health (including attainment of the recommended maximum contaminant levels).

The Committee intends that intake water quality standards should be prescribed by EPA only for those contaminants for which the Administrator determines that existing treatment techniques may be inadequate to assure achievement of recommended maximum contaminant levels (i.e., health goals). If available techniques are adequate to achieve these levels regardless of the quality of the intake water to which the techniques are applied, then no intake water quality regulation should be prescribed.

On preserving local authority:

The Committee seeks to achieve the primary purpose of protection of the public health while leaving to State and local governments and the public water systems maximum flexibility in determining whether to achieve this purpose by reliance on clean source water, treatment technology, or other effective means.

Except with respect to those contaminants for which a treatment technique requirement is established rather than a maximum contaminant level, State, local, and public water system discretion should be constrained only to meet minimum criteria, such as those preventing the system from being left unattended by competent personnel or requiring regular cleaning of equipment and facilities. The technical details of how to operate an efficient public water system should not be dictated by regulations under this authority, except to the extent reasonably necessary to assure that treatment technique requirements promulgated as part of the national primary drinking water regulations are effectively implemented.

On regional public water systems:

It is evident that what is a reasonable cost for a large metropolitan (or regional) public water system may not be reasonable for a small system which serves relatively few users. The Committee believes, however, that the quality of the Nation's drinking water can be upgraded only if the systems which provide water to the public are organized so as to be most cost-effective. In general, this means larger systems are to be encouraged and smaller systems discouraged. For this reason, the Committee intends that the Administrator's determination of what methods are generally available (taking cost into account) is to be based on what may reasonably be afforded by large metropolitan or regional public water systems.

This, of course, means that some small water systems which cannot afford the methods determined by the Administrator to be "generally available" will be unable promptly to comply with all primary regulations. For this reason, authority to grant exemption from the effective date of the primary regulations and thus to delay the date for compliance by public water systems has been provided in section 1416. However, this period should be used to develop a regional water system which can afford to purchase and use such methods, to seek additional sources of funding such as State aid, or to develop a plan for otherwise serving the affected population after any existing inadequate system is closed.

On a prohibition against requiring the addition of a substance:

The Administrator under this section would be prohibited from requiring the addition of any substance other than for the purpose of treating contaminants. Thus, EPA could not require the addition of fluorides or other substances to a public water system for medicinal purposes. Nor could EPA prevent the addition of fluorides or other substances up to the maximum amount allowable under a maximum contaminant level. While EPA could not require the addition of a substance for medicinal purposes, the Agency would have full authority to limit the addition of such a substance if necessary to prevent excessive levels from occurring or to prevent such substance from interfering with the effectiveness of any required treatment techniques.

On the regulation of underground injection:

First, potential as well as presently-used drinking water sources are to be protected. Second, the protection is to apply to any injected substance (or derivative thereof) whether or not that substance is a contaminant subject to national primary drinking water regulations. Thus the injection is to be subject to regulation or prohibition if the injected substance may cause or contribute to noncompliance with a national primary drinking water regulation or if it may otherwise adversely affect the public health, including causing or contributing to the water's unfitness for human consumption.

The definition of "underground injection" is intended to be broad enough to cover any contaminant which may be put below ground level and which flows or moves, whether the contaminant is in semi-solid, liquid, sludge, or any other form or state.

This definition is not limited to the injection of wastes or to injection for disposal purposes; it is intended also to cover, among other contaminants, the injection of brines and the injection of contaminants for extraction or other purposes. While the Committee does not intend this definition to apply to septic tanks or other individual residential waste disposal systems, it does intend that the definition apply to a multiple dwelling, community, or regional system of injection of waste.

....the Committee adopted an amendment expressing its intent not to authorize needless interference with oil or gas production. This amendment prohibits regulations for State underground injection control programs from prescribing requirements which would interfere with production of oil or natural gas or disposal of such biproducts associated with such production, except that such requirements are authorized to be prescribed if essential to assure that underground sources of drinking water will not be endangered by such activity.

The Committee's intent in adopting this amendment was not to require EPA to bear an impossible burden of proof as a condition of promulgation of any such regulation. Rather, the Committee sought to assure that constraints on energy production activities would be kept as limited in scope as possible while still assuring the safety of present and potential sources of drinking water.

Relationships between the Safe Drinking Water Act and the Federal Water Pollution Control Act

There are potential functional overlaps and areas of conflicts between the Safe Drinking Water Act (SDWA-PL93-523) and the Federal Water Pollution Control Act (FWPCA-PL92-500). The areas of potential overlaps are in (1) regulations, (2) research, (3) development and dissemination of information and technology, (4) technical assistance to states and municipalities, (5) manpower training, (6) planning, and (7) financial incentives.

Regulations. The interface between the FWPCA and the SDWA in their respective regulatory elements is in the regulation of underground waste injection and in the emergency powers section (1431) which authorizes EPA to act to protect persons from an imminent and substantial endangerment to their health.

Congress intended the emergency powers authority to be broad enough to permit EPA to issue orders to area or point source polluters whose action or inaction may or does require prompt control to protect public health. This type of emergency order may be issued and enforced irrespective of any permit, license, regulation, or order. The SDWA can be used to regulate discharge of a contaminant which is otherwise regulated under the FWPCA, if the emergency powers criteria of an imminent and substantial endangerment is met.

Because a direct hydrologic linkage between endangered water supply and pollution source must be established, the use of the SDWA is a case-by-case approach as opposed to a uniform effluent system of the FWPCA.

The SDWA also provides for minimum intake water quality standards for a limited class of pollutants and similarly many of PL-92-500's water quality standards are established for the purpose of drinking water source protection. Intake standards established under the SDWA may require modification of incompatible water quality standards and any effluent limitations adopted under PL92-500.

Research. Under PL 93-523, EPA is authorized to conduct research studies and demonstrations relating primarily to health effects of contaminants, treatment technology, monitoring equipment, and ground water protection. A research program on the order of $75 million over the next three years has been proposed.

This research program has been started and will not be delayed until after the completion of the NAS study. Health effect research and underground protection research are two principal areas of interest.

Research effort under PL 92-500 in the area of ground water contamination will be supplemented by PL 93-523 funds.

Records and reporting. Congress has found that the public is not aware of the extent and danger of contaminated drinking water supplies. To remedy this situation, PL 93-523 requires that public water systems notify the public when certain failures occur: (a) failure to comply with a maximum contaminant level, (b) failure to use any of the required treatment techniques, (c) failure to perform testing or monitoring, (d) when a system has received a variance or exemption, and (e) failure to comply with a schedule or control measure.

PL 92-500 requires municipal dischargers to establish and maintain records and provide reports and other information. Although notices are not required, except for the spill of oil or hazardous materials, the importance of information collection and dissemination is stressed. Since most systems supplying drinking water are also responsible for waste treatment, there appears to be an opportunity to consolidate or coordinate certain information collecting and reporting requirements.

Technical assistance. PL 93-523 specifies that EPA will provide technical assistance to states and municipalities in the establishment and administration of public water system supervision programs. Assistance is also implicitly required by other sections of the SDWA.

PL 92-500 similarly calls for technical assistance covering program management, technology transfer, and monitoring. This type of technical assistance overlaps activities required by PL 93-523.

Manpower training. The SDWA authorized EPA to pay all or part of the costs of programs designed to train operators, inspectors and supervisory personnel involved in the public health aspects of providing safe drinking water. PL 92-500 incorporates a similar training authority. Since many of the institutions and agencies currently receiving training grants would no doubt also participate in the PL 93-523 training program, there appears to be an opportunity to consolidate, or at least closely coordinate, the two programs.

Planning. PL 93-523 does not explicitly call for planning but a number of requirements of the Act do necessitate planning activities. The requirements for planning in the siting of new facilities to include consideration of protection from floods and other natural disasters and sources of supply is an example. Planning the protection of underground sources of drinking water based on development patterns and other such factors in another example.

The planning required to implement PL 93-523 should be closely coordinated with other water planning efforts such as those of the Corps of Engineers, Soil Conservation Service, Bureau of Reclamation, river basin planning under the Water Resources Council, and EPA's water quality planning under PL 92-500. EPA's 208 areawide planning and 303 river basin planning should be of particular significance to the planning implied in PL 93-523.

Financial incentives. Both PL 92-500 and PL 93-523 rely heavily on financial incentive. They both provide for grants to states to assist them in the administration of their control responsibilities, grants for special studies and demonstration projects, and training grants.

PROVISIONS OF THE ACT

The Safe Drinking Water Act is a relatively clear, unambiguous law that is designed to allow actual implementation by the state rather than total Federal assumption of responsibility for enforcement. The Act authorized EPA to adopt regulations that prescribe general guidelines for state assumption of primacy for enforcement that will give them sufficient latitude to establish programs that meet the special or unique needs of a state.

The Act is a comprehensive, well integrated set of provisions that should give the states all required tools to protect their public drinking water supplies. The sections that follow provide a brief description of the more important aspects of the Act itself. Much of this section is paraphrased language from the Act but there are some parts that are the authors own interpretations of what is intended. These interpretations may not coincide with those of EPA and should not be taken as reflecting EPA policy unless specifically noted.

Applicability of the Act

The Act applies to:

1. all public water supplies, both municipal and investor-owned; and

2. Federal agencies having jurisdiction over Federally-owned or maintained public water systems, except under waiver of compliance in the interest of national security.

The Act does not apply to a system if all of the following conditions are met:

1. it consists solely of distribution and storage;
2. it obtains water from, but is not owned or operated by a public water system (e.g., hotels);
3. it does not sell water to any person (e.g., captive industrial supplies); and
4. it does not convey water to passengers in interstate commerce.

An estimate of the number of public water supply systems to which the Act is applicable is given in the table below.

Table 1

Public Water Supply Systems in the United States

Type of System	Number of Systems	Estimated Population Served
Community System	40,000	160 million
Ground Supply	32,000	53 million
Surface Supply	8,000	107 million
Other Public Systems	200,000	
Ground Supply	190,000	
Surface Supply	10,000	

Water Facility Siting Provisions

The Act and the Regulations both include provisions to require notice before a new water supply is developed or an existing supply modified. The purpose of this provision is to avoid problems associated with poor facility location choices. Before a water supplier may enter into a financial commitment for, or initiate construction of a new public water system, or increase the capacity of an existing water system, he must notify the state. To the extent practicable, a supplier should avoid locating the new or expanded facility at a site which is subject to earthquakes, floods, fires, or other man-made disasters which could cause breakdown of the public water system. Normally, except for intake structures, facilities should not be located within the floodplain of a 100-year flood, or lower than the recorded high tide where appropriate records exist. The EPA will not seek to override land use decisions affecting public water system siting which are made at the State or local government levels.

National Primary Drinking Water Regulations

The Act directs EPA to adopt national drinking water regulations related to public health that are applicable to all public water supplies. Procedures under the Act are for EPA to first propose interim primary regulations, (this was done on March 14, 1975) and then to promulgate these interim regulations, (this was done on December 24, 1975) that will become effective 18 months later or on June 24, 1977. These interim primary regulations will be revised on the basis of a National Academy of Science study which is to be completed by December 1976.

The National Academy of Sciences is conducting its study of the maximum contaminant levels that should be allowed in drinking water to assure that the health of persons will be protected against known or anticipated adverse effects and to allow an adequate margin of safety. The NAS will also develop a list of contaminants, the levels of which in drinking water cannot be determined but which may have an adverse effect on the health of persons as some undetermined level. EPA will use this list in deciding whether to include such contaminants and whether to prescribe treatment technique requirements in a national primary drinking water regulation. The NAS study is to be reported to Congress no later than two years after the date of Act.

In conducting its study, the NAS is directed to consider only what is required to protect public health, not what is technologically or economically feasible or reasonable. The NAS recommended contaminant levels are to protect susceptible groups in the population; to take into account long-term exposures, exposures to contaminants in other media, and synergistic effects of multiple contaminants; to take into account body changes reasonably suspect of increasing the risk or severity of illness; and to incorporate an adequate margin of safety.

Based on results of a NAS study, EPA may specify additional contaminants with adverse health effects, it may establish new maximum contaminant levels, it may prescribe a list of known water treatment techniques which will reduce the concentration of any contaminant for which no maximum contaminant level is established (e.g., viruses, organics, asbestos), or it may establish requirements for operation and maintenance. These regulations:

1. shall be amended whenever changes in technology, treatment techniques and other means permit greater protection of the health of persons; and

2. must be reviewed once every three years, for possible revision.

The primary drinking water regulations may be enforced by either or both Federal and state governments. The following subsections review the applicability and enforcement of these primary drinking water regulations. There are provisions for exceptions and variances, for notification of violations and for monitoring and reporting under these regulations.

General considerations. The general considerations for the primary regulations are:

1. these regulations are to protect health to the extent feasible, using technology, treatment techniques, and other means generally available when costs are taken into consideration;

2. after submission in December 1976 of the study by the National Academy of Science to Congress, EPA will publish its Revised National Primary Drinking Water Regulations; and

3. the effective date for the Revised Primary Regulations is to be eighteen months after promulgation.

Specific considerations. Specific considerations of Primary Regulations are that these regulations:

1. apply to all public water systems;

2. specify contaminants that may have any adverse effects on the health of persons;

3. specify for each contaminant either:

    a. a maximum contaminant level, if it is economically and technologically feasible to determine that level in water; or

    b. if it is not feasible to determine that contaminant level, they specify each known treatment technique that will reduce the contaminant concentration to a level that will meet the Regulations; and

4. contain criteria and procedures to ensure that a supply will dependably comply with the allowable contaminant levels, including:

    a. quality control and testing procedures to ensure proper operation and maintenance of a system, and

    b. requirements as to:

(1) minimum quality of water that may be taken into the system, and

(2) the siting of new facilities; but

5. may not require the addition of any substance for preventive health care purposes unrelated to contamination of drinking water.

Exemptions and Variances from National Primary Drinking Water Regulations

The Act provides for a system of either state or EPA issued exemptions and variances that allow at least temporary, conditional use of a water supply that fails to meet a Primary Regulation. Because of the incorporation of compliance schedules in all exemptions and variances, it is anticipated that eventually virtually all public water will comply with the Primary Regulations. Some exceptions under the variance provisions may be possible so that a system may never have to come into compliance if certain conditions exist (e.g., adequate technology is not available).

Exemptions. By state approval, one or more exemptions may be obtained for any supply either with respect to meeting maximum contaminant level regulations, or a treatment requirement that is specified as a Primary Regulation.

The reason for granting an exemption for systems that were in operation at the time that a Primary Regulation became effective is:

1. that compelling factors such as economics prevent a public water supply system from meeting either a maximum contaminant level, or a treatment technique requirement; and

2. that granting an exemption will not result in an unreasonable risk to health.

Exemptions are relatively short-termed, depending on financing, construction, and other factors, and have finite deadlines for discontinuance. The conditions for granting an exemption to a public water supply are:

1. that within one year after granting an exemption, a state must issue a schedule of compliance that contains deadlines for increments of progress for each element in the Primary Regulations not met;

2. that any control measures specified by the state as a condition must be implemented;

3. that the state provides notice and opportunity for public hearing because of schedule of compliance is ordered; and

4. that the public water supply meet the compliance schedule to lift the exemption, as expeditiously as practicable, but certainly by the specific deadlines.

Specific deadlines for exemptions are:

1. for those based on the Interim Primary Regulations, all single public water systems must be in compliance by January 1, 1981; and

2. for those based on Revised Primary Regulations, seven years after the effective date of a revised regulation and an additional two years may be granted to supplies joining a regional system.

EPA and a state must act on an application for exemption within a reasonable period of time after it is submitted.

EPA has the responsibility for granting exemptions if a state does not have primary responsibility for enforcement under provisions of the Act.

Enforcement of an exemption compliance schedule is to be under state law, or by EPA if a state does not qualify for enforcement responsibility.

Variances. The reasons for granting a variance are:

1. that the available sources of raw water have characteristics that cannot meet requirements respecting maximum allowable contaminant levels, despite the application of best available technology, treatment techniques, or other means, taking costs into the consideration and that unreasonable risk to public health will not result; or

2. that a public water system demonstrates to the state's satisfaction that a treatment process specified by the Regulations is not necessary to protect the health of the persons, because of the nature of the raw water source of such a system. (Such a variance is conditioned on monitoring or other requirements as EPA may prescribe.)

The conditions for granting variances are that:

1. before a proposed variance may take effect, a state must provide notice and opportunity for public hearing;

2. if a state grants a variance, it must, within one year, provide a schedule for compliance including increments of progress and the system must implement any control measure that the state may require;

3. before a state-prescribed schedule may take effect, it must provide notice and hold a public hearing on granting the variance subject to the prescribed compliance schedule;

4. if a variance is granted, the water supplier must undertake to meet the compliance schedule as expeditiously as practicable as the state determines may reasonably be achieved; and

5. a variance must be conditioned on compliance by the public water system with the prescribed timetable in the schedule.

The Act provides for procedures for EPA approval, review and revocation of a state issued variance.

EPA has the responsibility for granting variances if a state does not have a primary responsibility for enforcement of the Act

There are no absolute deadlines for revocation of a variance.

Except as subject to the requirements of a schedule of compliance, a variance may be continued indefinitely. Variances are to be reviewed every three years, but will not be revoked or rescinded unless there is a definite change in technology available.

National Secondary Drinking Water Regulations

The National Safe Drinking Water Act also provides for the establishment of an additional set of standards that are to prescribe maximum limits for contaminants that tend to make water disagreeable to use, but that do not have any particular adverse public health effect. These are anticipated to be organics that result in color and odor, inorganics such as iron and manganese that cause color and turbidity, and other chemicals that impart a noticeable and disagreeable taste. These standards for esthetic quality that effect the public welfare are to be incorporated in the Secondary Drinking Water Regulations.

A Secondary Drinking Water Regulation is one that:

1. applies to all public water systems;
2. specifies maximum contaminant levels necessary to protect the public welfare, if these contaminants
   a. adversely affect the odor or the appearance of water causing a substantial number of persons to discontinue its use, or
   b. adversely affects the public welfare in some other way; and
3. is not enforceable by EPA, but may be enforced by a state and that may vary according to geographic and other circumstances.

It is anticipated that the Secondary Drinking Water Regulations will be proposed by EPA early in 1976 and that they will be promulgated in late 1976 or early 1977 after a review period. An opportunity for public hearings must be provided in the establishment of these regulations.

If within a reasonable time after promulgation of the Secondary Regulations, EPA determines that a state has not enforced these regulations and that a number of public systems have failed to comply with these regulations, then EPA will notify the state that it is not taking reasonable action with respect to these regulations.

It is anticipated that the Secondary Regulations will provide maximum contaminate levels for chlorides, copper, manganese, iron, zinc, sulfates, color, odor, hydrogen sulfide, foaming agents, and the corrosivity of water. The maximum contaminate levels will in all likehood be the same as those in the 1962 PHS standards. Fairly rigorous monitoring requirements will also probably be included in any National Secondary Regulations with the frequency similar to that required for community water systems under the Primary Regulations. Listed below is a table giving the anticipated secondary maximum contaminant levels.

Table 2

Anticipated Maximum Secondary Contaminant Levels

Contaminant	Level
Chloride	250 mg/1
Color	15 Color Units
Copper	1 mg/1
Corrosivity	Non-corrosive
Foaming Agents	0.5 mg/1
Hydrogen Sulfide	0.05 mg/1
Iron	0.3 mg/1
Manganese	0.05 mg/1
Odor	3 Threshold Odor Number
Sulfate	250 mg/1
Zinc	5 mg/1

<u>Enforcement of the Act</u>

The Act clearly contemplates that the states will be responsible for enforcing the requirements of the law and the various regulations adopted by EPA. To help the states administer the Act, funds are allocated to each state with the stipulation that the Federal funds cannot exceed 75 percent of the total program costs. In addition, the states cannot reduce their present financial effort. A state need not take over administration of all of the elements of the Act, but can be designated by EPA to only enforce certain regulations. A state may also choose to accept responsibility for operation of the Act over a period of years.

<u>Requirements for primary enforcement</u>. Primary enforcement responsibility rests with a state providing that:

1. the state adopts drinking water regulations to no less stringent than the Interim or Revised Primary Regulations, whichever are in effect;

2. the state has adopted and is implementing adequate procedures for enforcement of the Regulations, including monitoring and inspections as may be required by EPA;

3. the state keeps records and reports to EPA as may be requested;

4. the state will not issue exemptions and variances that are less stringent than those called for by the Act and the regulations;

5. the state has adopted and can implement an adequate plan for provision of safe drinking water under emergency conditions; and

6. the state requests that it be delegated this authority.

Grants to states. Financial grants are given only to states that:

1. have programs for enforcing drinking water regulations;
2. have established (or will establish within one year of a grant) a public water system supervision program; and
3. will assume primary enforcement responsibility for public water supply systems within the state.

State program regulations. EPA has proposed and promulgated (January 20, 1976) the manner in which a state may apply for designation and authority to enforce the Act. The state governors have been notified of the promulgation of these regulations and the states should now apply to EPA for approval of their enforcement plans and programs. EPA approval of state's program will be based upon the following:

1. the period for which that approval will apply;
2. EPA's determination that the state enforcement program is adequate; and
3. public hearings held on the state enforcement program.

Failure of a state to enforce. EPA may find that a state is failing to enforce the Act. The procedure is such a case is as follows:

1. If EPA finds that a state is not enforcing compliance of the primary regulations for any system, it will notify the state and offer to provide advice and technical assistance that may be needed to bring the system into compliance;
2. if after such a notice the failure to comply extends more than 30 days EPA will:
    a. give public notice of its finding; and
    b. give the state 15 days to report on steps taken to bring the system into compliance, including reasons;
3. if the state does not obtain compliance after more than 60 days and if a state fails to submit a report, or if

the report is unacceptable to EPA, then EPA may determine that the state has abused its discretion in carrying out its enforcement responsibility; and

4. EPA may commence a civil action to obtain compliance.

EPA enforcement. In a state without primary enforcement responsibility, EPA may find that a system is in noncompliance. It may then commence a civil action against the public water supply in U.S. District Court. The Court may enter a judgment against the water system and impose a fine of up to $5000 per day of noncompliance. If a suit is brought and judgment rendered, the public water supply system must notify all of its customers.

State enforcement. In a state that has primary enforcement responsibility, if the state makes a finding of noncompliance with the Act, on the part of a public system, it will proceed as follows:

1. the state may petition EPA for assistance;
2. the state may hold public hearings to gather technical information and to determine methods of obtaining compliance;
3. EPA may issue recommendations based on such hearings;
4. the state should determine ways to bring a system into compliance in the earliest possible time; and
5. the state will establish the best means for maximum feasible protection of public health.

Citizen suits in U.S. District Court. The Act permits citizen suits in order to give the public an opportunity to force the states and EPA to obtain compliance with the Act and the various regulations. The conditions for such suits are as follows:

1. a suit may be brought by any person on his own behalf (no class action suits) against:
   a. any person or water system,
   b. the U.S. Government,
   c. any governmental instrumentality, or
   d. EPA;

2. the limitations on a citizen suit are that:
   a. no suit against a public water supply may be instituted between December 17, 1975 and February 1, 1978;
   b. no civil action may be commenced until 60 days after the plaintiff has notified EPA, the alleged violator, and the state in which violation occurred;
   c. no civil action may be commenced if EPA, the Attorney General or the state has commenced action to require compliance; and
   d. no person may commence a civil action on an exemption or variance, unless he shows that a state has failed to prescribe compliance schedules in a substantial number of cases.

Emergency powers. EPA may take whatever action is necessary when a contaminant is present in, or is likely to enter a public water system such as to pose an imminent and substantial endangerment to public health when the appropriate state and local authorities have not acted. EPA must consult with state and local authorities if practicable.

Guaranteed Loans

The Act makes some funds available for loans to small public systems, but limits the amount of indebtedness for each system to \$50,000. The aggregate amount of indebtedness cannot exceed \$50 million for such systems. EPA is authorized to guarantee loans to small public systems in FY 75 and 76 if:

1. improvements are necessary to meet primary drinking water regulations; and

2. the system cannot obtain financial assistance in any other manner.

GROUNDWATER REGULATIONS

Control of Pollution of Groundwater Sources

In recent years there has been considerable interest in many state water supply agencies on methods of controlling pollution of groundwater sources. Public Law 92-500 (the 1972 amendments to the Federal Water Pollution Control Act) provided mechanisms for the abatement of pollution of streams and lakes, but it offered almost no regulatory control in the protection of underground drinking water supplies.

The 1972 Act did specify that EPA should cooperate with Federal, State, and local agencies and industries to develop comprehensive programs to prevent or eliminate pollution of groundwater to improve the sanitary conditions of underground water. PL 92-500 provides for groundwater quality monitoring programs and for EPA guidelines for the disposal of pollutants in wells and subsurface excavations. It also calls for state operated permit programs to control the disposal of pollutants into wells.

Under the National Pollutant Discharge Elimination System provisions of 92-500, EPA is requiring NPDES permits under the following conditions:

(1) when a surface discharge permit is already in effect; and

(2) when there has been a surface discharge that has been replaced by a subsurface disposal system.

In April of 1974, EPA issued "Administrator's Decision Statement No. 5" as the agency policy on the protection of subsurface waters. Under this policy, EPA opposes the emplacement of pollutants by subsurface injection without strict control and without a clear demonstration that waste injection will not interfere with the present or potential use of the subsurface groundwater resources, or otherwise damage the environment.

EPA will require that all proposals for injection be critically evaluated to determine that appropriate guidelines have been followed. EPA has set the policy that underground disposal should be used only as a temporary means of disposal and that it be discontinued when new treatment and disposal technology becomes available.

Decision #5 (ADS-5) was drafted to protect groundwater from contamination resulting from improper injection practices and from poorly sited injection wells. Guidelines are provided for engineering and geological safeguards to protect the integrity of the subsurface environment. These guidelines are directed at preliminary investigations, design, construction, operation, monitoring, and abandonment phases of injection well projects. Decision #5 also encourages development of alternative means of disposal.

Control of Underground Injection Under PL 93-523

Although some control of groundwater pollution was provided in PL 92-500, Congress felt that greater protection should be afforded groundwater sources of public water supplies. This protection was provided via sections of the National Safe Drinking Water Act that require that each state adopt regulations to control underground injections.

Practices to be Regulated

Underground injection practices that will be encompassed by state regulations are: injections by municipal and industrial waste disposal wells, gas storage wells, subsidence control wells, mining wells, barrier wells, recharge wells, underground injection of brine or other fluids brought to the surface in connection with oil or natural gas production, underground injection for secondary or tertiary recovery of oil or natural gas, agricultural drainage wells and urban runoff wells.

Congress did not intend for individual septic tanks to be controlled by these state regulations, but it did intend to include those from multiple dwellings and to include industrial and municipal wastewaters that may be injected into the ground. This section of the Act uses the term "underground injection" which means the subsurface emplacement of fluids by well injection.

The subsurface emplacement of fluids by well injection would include traditional deep well injection of industrial or municipal wastes; however, the nature of the fluid emplaced and the depth of injection should not be the limiting elements in determining which well injection practices are to be covered by the underground regulations. Subsurface emplacement by well injection may be taken to mean a practice where subsurface disposal is the principal function of the well.

The term "well" may be interpreted broadly and the scope of these regulations will be determined by EPA in its proposed regulations. An underground injection will endanger a drinking water source if the injected fluid increases or causes an increase in contaminant levels in water that is used as a supply source to the extent that the water will not comply with the Primary Drinking Water Regulations, or if the water may otherwise adversely affect the health of persons.

EPA regulations on underground injection will not cover many practices that commonly endanger underground drinking water. Leakage from sewer mains, septic systems, highway salting and leaching from land-fills are often serious sources of contamination of underground drinking water, but they are not underground injection practices and are not regulated by the Safe Drinking Water Act. Surface impoundments such as pits, ponds, and lagoons used for the treatment or disposal of industrial or municipal waste also represent potential dangers to underground sources because of percolation of contaminants through the sides and bottom of impoundments. Surface impoundments could technically be classified as dug wells for injection purposes as the principal function of some impoundments is the subsurface emplacement of fluids; however, it is extremely difficult to define and identify those pits, ponds and lagoons which function as injection wells and not include impoundments that result in only incidental percolation into underground strata.

EPA will probably initially regulate only those dug wells that can normally be recognized as wells and defer regulation of other types or surface impoundments that may function as injection wells. A dug well that may be regulated is one that has a depth that is greater than its largest surface dimension.

Procedure for the Adoption of Regulations

Regulations for underground control programs will be developed as follows:

1. EPA must publish a set of proposed regulations, but has not done so by June 1976 although drafts have been developed and circulated;
2. EPA must then hold public hearings before a set of revised regulations are published; and
3. EPA must publish revised regulations six months after their initial proposals.

State Programs to Control Underground Injection

It is the intent of Congress as expressed in the Safe Drinking Water Act that the various states have enforcement responsibility for groundwater quality. EPA is adhering to this mandate. For a state underground injection control program to be approved by EPA it must include:

1. minimum requirements to prevent underground injections that would endanger drinking water supplies;
2. prohibit injection after December 17, 1978, unless by special permit;
3. allow permits for underground injection only when the applicant can prove that injection will not endanger drinking water sources;
4. provide for inspection, monitoring, record keeping, and reporting to EPA; and
5. no requirements that interfere with underground water or brine injection in oil or gas production or water or brine injection for secondary or tertiary oil recovery so long as fresh water aquifers are unaffected.

State acceptance of responsibility. State responsibility for the enforcement of underground injection regulations will be determined as follows:

1. EPA will list those states where underground injection control programs are necessary (this may be done in a staged process);

2. each of these states must apply to EPA for approval of its program within 270 days after EPA publishes regulations on underground injection if they choose to accept program responsibility, and they must show that:

   a. the state has given public notice and held hearings;

   b. the state has adopted and will implement a control program; and

   c. the state will keep records and make reports as EPA may require;

3. within 90 days after a state's application, EPA may approve or disapprove the state program in whole or in part;

4. if approval is granted, the state has primary enforcement responsibility, until EPA revokes approval; and

5. if EPA reviews and revokes approval for cause, EPA has 90 days in which to rescind the disapproval or prescribe revised conditions.

If EPA modified its underground injection regulations, a state must submit a notice to EPA within 270 days showing that its control program meets the revised or added requirements.

Temporary permit system. A state may provide a temporary permit system when:

1. EPA authorizes a state to issue temporary permits;

2. a system of reasonable notice and public hearings on particular injection locations is provided; and

3. a temporary permit is valid only until December 17, 1978.

For temporary permits to be issued, a state must show:

1. that injection is less harmful to health than other disposal methods;

2. that available technology has been used to the fullest extent to reduce volume, toxicity, and potential health hazard of injected fluid;

3. that the state cannot process all applications before December 17, 1978;

4. that any adverse effect on the environment of temporary permits would not be significant;

5. that permits are to be issued only for existing injection systems; and

6. that adequate safeguards are provided.

Failure of a state to enforce. EPA may find that a state has failed to enforce its underground injection control program. The procedure in such a case is the following:

1. if EPA finds that the state program does not effectively protect ground water quality, or if there is a violation of EPA regulations, then EPA will notify the state;

2. if the violation lasts more than 30 days after the notification, EPA must give public notice and request the state to report within 15 days on steps being taken to comply with regulations; and

3. if the failure to comply lasts more than 60 days after notice or if the state's report is not satisfactory, EPA may being civil action against the persons who are in violation of the regulations.

If a state does not have primary enforcement responsibility for the underground injection regulations, EPA may bring civil action against any person thought to be in violation of a regulation. Violators are subject to fines of $5,000 per day of violation, or if such violation is willful, the penalty may be $10,000 per day. In September 1975, EPA completed its study of the environmental impact statement of the underground injection program and it has completed studies of the cost of implementing the program.

Protection of Sole-Source Aquifers

Provisions of the Act. Section 1424(e) of the Safe Drinking Water Act states that EPA may on its own initiative or on petition find that an area has an aquifer which is the sole or principal drinking water supply and that a significant hazard to public health would result. Once such a determination is made and published, no commitment for Federal financial assistance (grants, contracts, loan guarantee, or other) may be made by a Federal agency for any project which EPA finds may result in contamination of the area's aquifer and create a significant hazard to public health. If provided for by the law, Federal financial assistance may be used in such a case to plan or design projects to assure that the area's aquifer will not be adversely affected.

Constraints on proposed projects apply only to those that are Federally funded and those that will create a significant health hazard. EPA does not construe this last provision to require that a separate determination be made for each proposed project in a designated region that it will, in fact, create a public health hazard. A finding by EPA that a threat exists to the quality of the drinking water supply of a large population is sufficient to demonstrate that a significant public health hazard could be created. The general process will be for a review of each application for Federal assistance of a major project in an area where a sole-source aquifer designation has been made. Federal agencies that propose projects in such a region will be asked to prepare environmental impact statements that include the effects on the quality of water in the aquifer. The principal intent of requiring a review is to prevent the creation of a public health problem as a result of inadequate planning.

An EPA sole-source designation is not contingent on the existence or effectiveness of local and state controls to prevent pollution of the aquifer. The Safe Drinking Water Act does not provide for this inclusion of such factors in the decision of aquifer designation.

The Edwards aquifer designation. Shortly after PL 93-523 was signed by President Ford, the Sierra Club, the League of Women Voters and the Citizens for a Better Environment petitioned EPA to designate the Edwards Underground Reservoir as the sole source of the public water supply for the region of San Antonio, Texas. The Edwards aquifer is part of a belt of permeable waterbearing rock that includes the Comanche Peak, Edwards and Georgetown limestones. The segment of this aquifer known as the Edwards Underground Reservoir extends from near Brackettville in Kinney County eastward through Uvalde, Medina and Bexar counties and northeastward through Comal and to near Kyle in Hays county. The reservoir also underlies a small section of Atascosa, and Guadalupe and Kendall counties. The recharge zone, the area through which water enters into the reservoir, is located where the reservoir outcrops in these counties, the area within the 100-year floodplain of Cibolo Creek, beginning at Herff Falls in Kendall county and continuing downstream to the main outcrop area of the reservoir.

The upstream headwaters area drains into the recharge zone and contributes over 90 percent of the recharge flow of the aquifer. This is the streamflow source zone and it could have a significant impact on the quality of the water in the reservoir. This streamflow source zone includes the headwaters of the Nueces, San Antonio, and Guadalupe River basins above the recharge zone and includes much of Edwards, Real, Bandera, Kerr, and Kendall counties and parts of Kinney, Uvalde, Medina, Bexar, Comal, Hays, Gillespie, and Blanco counties within the watershed boundaries of the three basins.

EPA published the Sierra Club's petition in March 1975 and requested comments on the proposed designation. In June 1975, EPA held a hearing in San Antonio to allow the general public to express their views. Based on comments received, on the public hearings and on technical studies made by EPA and others, Mr. Russell Train signed a notice of determination on December 10, 1975 that found the following:

1. that the Edwards aquifer is the principal source of drinking water for about one million people in the San Antonio area including seventeen cities and towns, five military installations, and a large rural population, that current water supply treatment practice in the region is limited to disinfection and that there is no alternative source of drinking water supply which could economically replace this underground reservoir; and

2. that the aquifer is a distinct hydrologic unit, that it is vulnerable to contamination through its recharge zone, particularly from streams crossing the zone, that contamination of the aquifer would be difficult or impossible to reverse, and that contamination poses a significant hazard to those people dependent on the reservoir for drinking purposes.

<u>EPA guidelines on sole-source designations</u>. EPA has, as a part of its Edwards aquifer designation, provided guidelines that it will in all likelihood follow in other similar cases. Some of the elements of EPA's proposed procedures are:

1. that EPA does not wish to delay approval of the many minor and some major Federal actions that will have a negligible impact on ground water quality and that EPA will only review those major programs or actions which in its judgment may have a significant impact on the safety of drinking water;

2. that the major Federal financially assisted programs or actions located in the recharge zone with which the EPA will be primarily concerned are those which in its opinion are already subject to the provisions of the National Environmental Policy Act;

3. that Federal agencies originating projects which might contaminate the reservoir through the recharge zone, particularly if such projects involve hazardous or toxic materials will be requested to prepare an environmental impact statement, or a brief groundwater impact evaluation; and

4. that project review will be carried out in conjunction with EPA's consideration of draft and final environmental impact statements as presently required.

Citizens may still petition EPA to review projects other than those which the agency reviews on its own initiative but it will not be concerned with reviewing minor actions that have an insignificant impact on the quality of the reservoir such as individual home mortgage loans. Ordinarily EPA will review only projects determined to be significant enough to be subject to NEPA requirements and which are located in the recharge zone. EPA will review projects in the streamflow source zone upon petition or on an exceptional basis only. A petition to review a project in this area must reasonably demonstrate that the impact of the project in the streamflow source zone will be of a magnitude such that it may have a significant impact on the quality of a sole-source aquifer through the recharge zone. Federal agencies financing major actions or programs on the streamflow source zone should, in their environmental assessments and environmental impact statements, discuss the effect which such actions might have on the quality of any waters reaching the recharge zone.

SECTION TWO:

NATIONAL INTERIM PRIMARY DRINKING WATER REGULATIONS

MAXIMUM CONTAMINANT LEVELS

Background

In Part II of Volume 40 of the Federal Register of March 14, 1975, EPA published proposed Interim Primary Drinking Water Regulations for all public water supply systems. Subsequent to this time, public hearings on the proposed regulations were held across the United States in order to obtain knowledgeable comments. Additional input was obtained from Federal agencies, advisory councils, and other technical groups. From the evaluation of this broad range of technical critique, the proposed regulations were promulgated on December 24, 1975 as the National Interim Primary Drinking Water Regulations. Published as part of the regulations were the "water standards," or the maximum contaminant levels.

The maximum contaminant levels for arsenic, barium, cadmium, chromium, fluoride, lead, selenium, and silver are the same as those in the 1962 Public health Service Drinking Water Standards. Table 6, comparing the 1962 PHS standards and PL 93-523, is given on p. 58. With the exception of nitrates, all of the maximum contaminant levels of inorganic chemicals are based upon possible health effects that may occur after a lifetime of exposure of approximately two liters of water per day. Pesticide contaminants were not contained in the 1962 Standards. The maximum contaminant levels for pesticides have been derived from the recent data on effects of acute and chronic exposure to both organochlorine and chlorophenoxy pesticides. In setting specific limits for chemical constituents, the total lifetime environmental exposure of man to the specific toxicant has been taken into consideration. The limits have been determined with a factor of safety included to minimize the amount of toxicant contributed by water when other sources (milk, food, or air) are known to represent additional sources of exposure to man. On this basis maximum contaminant levels should not be regarded as fine lines between safe and dangerous concentrations.

Since the maximum contaminant levels were established to protect consumers based on long-term exposure to the water supply, it was clear that these contaminant levels should not apply to transients or intermittent users. Therefore, the final regulations on the maximum contaminant levels for organic chemicals, and for inorganic chemicals other than nitrates are not applicable to non-community systems. Since infants may be adversely affected by nitrates in a short period of time, the maximum contaminant levels for nitrate have been made applicable to non-community systems.

The regulations have a maximum contaminant level for turbidity because turbidity interferes with disinfection efficiency and because high turbidity often signals the presence of other health hazards. The growth of microorganisms in a distribution system is often stimulated if excessive particulate or organic matter is present. The maximum contaminant levels for microbiological contaminants are in terms of the surrogate coliform bacteria, although the purpose of the standard is to protect against disease-causing bacteria, viruses, protozoa, worms, and fungi. The analytical procedures for direct enumeration of these microorganisms are not well enough developed nor practicable for widespread application at this time. Total coliform counts have been used for nearly 100 years as indicators because the organisms are present in large quantity in the intestinal tracts of humans and other warm-blooded animals, thus the number remaining in a water supply provides a good correlation with sanitary significance.

Maximum Contaminant Levels for Inorganic Chemicals other than Fluoride

The maximum contaminant level for nitrate is applicable to both community water systems and non-community water systems. The levels for the other inorganic chemicals apply only to community water systems.

Contaminant	Level (mg/l)
Arsenic	0.05
Barium	1
Cadmium	0.010
Chromium	0.05
Lead	0.05
Mercury	0.002
Nitrate (as N)	10
Selenium	0.01
Silver	0.05

Maximum Contaminant Levels for Fluoride

The MCL's for fluoride were established at two times the concentration which is desirable for protecting teeth. The maximum contaminant levels of fluoride are a function of the maximum daily air temperature of the location of community water systems and are given below:

Temperature (in °F)	Level (mg/l)
53.7 and below	2.4
53.8 - 58.3	2.2
58.4 - 63.8	2.0

Temperature (in °F)	Level (mg/l)
63.9 - 70.6	1.8
70.7 - 79.2	1.6
79.3 - 90.5	1.4

Maximum Contaminant Levels for Organic Chemicals

The following are the maximum levels for organic chemicals. They apply only to community water systems.

Chlorinated Hydrocarbons	Level (mg/l)
Endrin (1,2,3,4,10,10-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo,endo-5,8-dimethano naphthalene)	0.0002
Lindane (1,2,3,4,5,6-Hexachloro-cyclohexane, gamma isomer)	0.004
Methoxychlor (1,1,1-Trichloro-2,2-bis [p-methoxyphenyl]ethane)	0.1
Toxaphene ($C_{10}H_{10}Cl_8$-Technical chlorinated camphene, 67-69% chlorine)	0.005
Chlorophenoxys	
2,4-D (2,4-Dichlorophenoxyacetic acid)	0.1
2,4,5-TP Silvex (2,4,5-Trichlorophenoxypropionic acid)	0.01

Maximum Contaminant Level of Turbidity

The maximum contaminant levels for turbidity are applicable to both community water systems and non-community water systems using surface water sources in whole or in part. The maximum contaminant level of turbidity at representative entry point(s) into the distribution system is a monthly average of one turbidity unit (1 TU). A maximum of five turbidity units (5 TU) may be allowed if the supplier can demonstrate to the state that this higher turbidity does not do any of the following:

1. interfere with disinfection;
2. prevent maintenance of an effective disinfectant agent through the distribution sytem; or
3. interfere with microbiological determinations.

Maximum Microbiological Contaminant Levels

Two methods applicable to community water systems and noncommunity water systems are used to describe the maximum coliform levels that must be met. The parameters used to judge compliance with these levels for each method are given in the following paragraphs.

Membrane filter. When the membrane filter (MF) technique is used, coliform densities shall not exceed any of the following:

1. one per 100 milliliters as the arithmetic mean of all samples examined per month;
2. four per 100 milliliters in more than one sample when less than 20 are examined per month; or
3. four per 100 milliliters in more than 5 percent of the samples when 20 or more are examined per month.

Fermentation tube method. When the fermentation tube method is used and when 10 milliliter standard portions are analyzed, coliform bacteria shall not be present in any of the following:

1. more than 10 percent of the portions in any month;

2. three or more portions in more than one sample when less than 20 samples are examined per month; or

3. three or more portions in more than 5 percent of the samples when 20 or more samples are examined per month.

When 100 milliliter standard portions are analyzed, coliform bacteria shall not be present in any of the following:

1. more than 60 percent of the portions in any month;

2. five portions in more than one sample when less than five samples are examined per month; or

3. five portions in more than 20 percent of samples when five samples or more are examined per month.

Summary of maximum microbiological contaminant levels. In the following table is a summary of previous microbiological standards.

Table 3

Maximum Microbiological Contaminant Levels

	MCL shall not exceed any of the following:		
Coliform Method	Per Month	Less than 20 Samples/Month	More than 20 Samples/Month
100 ml[1]	1/100 ml arithmetic mean	4/100 ml in one sample	4/100 ml in 5% of samples
10 ml[2]	10% of portions	3 portions in one sample	3 portions in 5% of samples
100 ml[2]	60% of portions	5 portions in one sample (if less than 5 samples per month	5 portions in 20% of samples if more than 5 samples per month

Compliance for communities and non-communities requiring less than 4 samples per month shall be based using a 3-month period.

1 & 2 refer to either membrane filter or fermentation tube method, respectively.

Sample period for small water systems. For community or non-community systems that are required to sample at a rate of less than 4 per month (population of less than 4,100), compliance with any of the methods shall be based upon sampling during a three-month period, except that, at the discretion of the State, compliance may be based upon sampling during a one-month period.

Analyses Eliminated in Regulations

The proposed regulations published in March 1975 included three maximum contaminant levels which have been eliminated in the National Interim Primary Drinking Water Regulations.

Carbon chloroform extract (CCE). This analysis was eliminated since it has many failings as an indicator of health effects. It is not clear that the CCE was reliable in identifying the most dangerous organic chemicals. There is no data from which a maximum contaminant level for CCE could be established. The CCE procedure for identifying level of organics in a water supply is useful as a screening technique; at this time it should not be required as a regulatory device. A community should not be found in default of the regulations based on analytical results that are so unspecific. EPA is seeking greater knowledge in the area organics so that rational decisions can be made concerning maximum contaminant levels for these substances. EPA has a two-pronged approach:

1. designated public water supplies will be monitored for organic constituents; and

2. EPA has begun researching the relevant topics in the organic chemical-health effects problem.

Cyanides. EPA's 1969 Community Water Supply Study did not indicate that cyanide was a problem under normal circumstances. Not a single public water supply was found to be at a level greater than one-thousandth of the level at which cyanide is toxic to humans. It is believed that cyanide will be present in toxic quantities only in an accident situation and that emergency action procedures described in the Act best handle these atypical conditions.

Standard plate count. Standard plate counts were eliminated from the regulations since it was believed that coliform limits and turbidity adequately control bacterial contamination. The total plate count procedure results in a non-specific arbitrary value. It comprises a diverse group of organisms, some of which in specific situations may have direct or indirect significance to public health. It is a useful control procedure, but only for some applications and its value depends upon prompt and professional laboratory assay. The manpower and the facilities currently available to the states are not sufficient to properly process these samples in a timely fashion. The application of this technique was left to the judgment of the individual state and local health authorities and regulating agencies.

Contaminants to be Considered for Regulation

In addition to organic carbon contaminants in water there is considerable interest in the possible health effects of sodium and sulfate. The National Drinking Water Council has recommended monitoring of these constituents, but has not recommended establishment of maximum contaminant levels. The National Academy of Sciences is researching this subject and will report on it in December 1976. A brief discussion of the problems associated with each of these three contaminants is given in the following subsections.

Sulfates. The presence of sulfate ion in drinking water can result in a cathartic effect. Both sodium sulfate (Glauber salt) and magnesium sulfate (Epsom salt) are well-known laxatives. The laxative dose for both is about two grams. Two liters of water with about 300 mg/l of sulfate derived from Glauber salt, or 390 mg/l of sulfate from Epsom salt, would provide this dose. Other forms such as calcium sulfate are less active as laxatives. This laxative effect of sulfates in water supplies is commonly noted by newcomers and visitors. People evidently become acclimated to sulfates in water in a relatively short period. The laxative effects of sulfates are experienced by more sensitive persons, not accustomed to a water at a lower content than by the average acclimated resident at a much higher content. When sulfates plus magnesium exceed 1,000 mg/l, a majority indicate a laxative effect even with acclimation. The table below indicates the relative sensitivity of people to different levels of sulfate and sulfate associated with magnesium.

Table 4

Water Quality as Related to the Presence or Absence of Laxative Effects

Determination	Range, mg/l	Percent of Persons Indicating a Laxative Effect
Magnesium plus sulfate	0-200	21
	200-500	21
	500-1,000	23
	1,000-1,500	64
	1,500-2,000	60
	2,000-3,000	81
	over 3,000	83
Sulfate	0-200	22
	200-500	24
	500-1,000	33
	1,000-1,500	62
	1,500-2,000	69
	2,000-3,000	75
	over 3,000	100

Sodium. Human intake of sodium is greatly influenced by the use of salt on food. For American males it is estimated to be 10 grams of NaCl per day, with a range of 4 to 24 grams or 1600 to 9600 mg/day of sodium and intake on this order is not considered to have an adverse effect on the normal individuals. An intake of 2000 mg of sodium can be allowed for most adults without a family history of hypertension.

Salt restriction is an element in the management of patients with hypertension, heart failure, kidney failure, cirrhosis and certain other less common conditions. Epidemiologically and in experimental animals, high sodium ingestion has been related to the development of hypertension, but only at very high doses of sodium. When fluid retention in the body results in edema and ascites, there is also a diminished urinary excretion of sodium. If the sodium intake is restricted in these circumstances, fluid retention may not occur as the excess water can be excreted as a result of body mechanisms that seek to maintain the concentration of sodium in the extracellular fluids. The taste threshold of sodium in water depends on the anion involved and water temperature. The taste thresholds are 500 mg/l from sodium chloride, 700 mg/l from sodium nitrate, and 1000 mg/l from sodium sulfate. A heavy user of salt on food has a higher taste threshold (50 percent higher) and the tastes are less detectable in cold water.

A concentration of sodium in drinking water up to 20 mg/l is considered compatible with most patients on low salt diets. When the sodium content exceeds 20 mg/l, a physician should take this into account to modify the diet or prescribe that distilled water be used. Water utilities that distribute water that exceeds 20 mg/l should inform physicians of the sodium content of the water so that the health of consumers can be protected. About 40 percent of the water supplies are known to exceed 20 mg/l and would be required to keep physicians informed of the sodium concentration. A 1963 survey on sodium levels in public water supplies found the following percent distribution of sodium concentration:

Range of Sodium Ion Concentration (mg/l)	Percent of Total Samples (%)
0-19.9	58.2
20-49.9	19.0
50-99.9	9.3
100-249.9	8.7
250-399.9	3.6
400-499.9	0.5
500-999.9	0.7
Over 1,000	0.1

Organic chemicals. As noted in an earlier section of this text, a maximum limit on carbon chloroform extractables was proposed in the March 1975 draft of the interim primary drinking water regulations and the reasons for not including CCE's in the final version of the regulations was discussed in that section. However, there is still considerable interest in setting some limit on organics in water.

The interim regulations do not include a general standard to limit organic chemicals, some of which have been the subject of concern due to possible carcinogenic potential. Some of these chemicals have been detected in very low concentrations in some public water supplies. EPA intends to set appropriate limits when sufficient information is available to determine the relationship between a general parameter for organics and levels of specific organic chemicals. Information is needed on the health significance of low concentrations of these substances, and on the feasible treatment and removal techniques.

The organics that have been identified in drinking water probably represent only a small fraction of the total organic compounds that can be found in drinking water. The remaining compounds are quite heterogeneous and include mixtures of high molecular weight organics not susceptible to rigorous chemical characterization. These substances can produce either halogenated organic compounded or oxidized forms, which may be hazardous to man when water is ozonated or chlorinated.

The positive identification of organic compounds in water appears to be an impossible task. The best analytical measures of organics that are now available are of questionable value as regulatory tools as they are all nonspecific and all subject to great variation in what contaminants they are actually measuring. Some of the techniques include CCE, carbon alcohol extractables, total organic carbon, volatile organic carbon, fixed organic carbon, and other more traditional parameters such as the BOD and COD.

EPA has a large number of studies underway to help answer some of the problems related to organics in drinking water as follows:

1. The National Organics Reconnaissance Survey, initiated in November 1974, has as its objectives to determine the extent of the presence of the four trihalomethanes (chloroform, bromodichloromethane, dibromochloromethane, and bromoform) in finished water, to determine whether or not these compounds are formed by chlorination, to determine the effects raw water source and water treatment practices other than chlorination could have on the formation of these compounds, and to characterize, as completely as possible the organic content of ten finished drinking water supplies. The field work of the Survey has been completed. The development of the field report is in progress.

2. A survey of eighty water supplies for the following six selected contaminants has been initiated: four trihalomethanes (chloroform, bromodichloromethane, dibromochloromethane, and bromoform), carbon tetrachloride, and 1,2-dichloroethane.

3. An investigation focusing on whether drinking water is a significant source of three pesticides (aldrin, dieldrin, and DDT has been ordered.

4. An investigation to identify and measure environmental levels of selected halogenated organic compounds and to determine the correlations of various levels with health effects observed in the exposed population has been initiated.

5. EPA promulgated as part of the National Interim Primary Drinking Water Regulations special monitoring regulations for organic chemicals. EPA has initiated further studies in 112 cities as a follow-up to the National Organics Reconnaissance Survey.

Time of Enforcement of the Maximum Contaminant Levels

The enforcement of the maximum contaminant levels will become effective 18 months after promulgation of the regulations. This date will be June 24, 1977. In the early stages of implementation of the regulations monitoring of community systems will receive priority over non-community systems. The reason for this is that there is concern that monitoring requirements for non-community systems would overtax the existing analytical laboratory facilities. This would be undesirable since the large majority of Americans are served by community water systems, and lack of laboratory facilities for monitoring might delay effective implementation of the regulations for those community water systems. For this reason, non-community systems will be given two years after the effective date of the regulations to begin monitoring. However, those non-community systems which are already being monitored are encouraged to continue this procedure. Further, those non-community systems which serve large numbers of persons are encouraged to take measures to test their water. Clearly, those non-community systems which pose threats to community health should be dealt with as soon as possible.

Summary of Analysis Required for Water Systems

Shown below is a table summarizing the required analysis for specific types of water systems.

Table 5

Summary of Analyses for Water Systems

Type of Water System	Water Source	Required Analysis
Community	Surface	Bacteriological Inorganic Organic Turbidity
Community	Ground	Bacteriological Inorganic Organic (if required by state)
Non-community	Surface	Bacteriological Nitrate Turbidity
Non-community	Ground	Bacteriological Nitrate

Comparison of 1962 Standards and SDWA MCL's

Table 6

Comparison of 1962 PHS Standards and Maximum Contaminant Levels of PL 93-523

Contaminant	Comparison
Inorganic chemicals	Mercury and nitrate added in PL 93-523
Fluoride	Same in both
Organic chemicals	Specific pesticides added in PL 93-523
Cyanide	Deleted in PL 93-523
Turbidity	Added in PL 93-523
Bacteriological	Same in both
Sampling frequency	Substantial modifications - generally to a lesser frequency in PL 93-523, but both regulations allowed flexibility to local authority

MONITORING AND REPORTING

This section includes the regulations relating to monitoring and reporting.

Inorganic Chemical Sampling

To establish an initial record of water quality, an analysis of substances to determine compliance with the maximum contaminant levels specified in the regulations must be completed for all community water systems utilizing surface water sources within one year after the effective date of the regulations. These analyses are to be repeated at yearly intervals. For community water systems using ground water sources, chemical analysis of the supply must be completed within two years and this analysis repeated at three-year intervals. Analysis for nitrate in non-community water systems, whether supplied by surface or ground water sources, must be completed within two years of the effective date of these regulations and these analyses are to be repeated at intervals to be determined by the State.

Maximum contaminant level exceeded. If the result of an inorganic chemical analysis indicates that the level of any contaminant exceeds the maximum contaminant level, the supplier of water shall report to the State within 7 days and initiate three additional analyses at the same sampling point within one month. If the average of the original and the three additional analyses exceeds the maximum contaminant level, notice must be given to the state and the public.

Monitoring after public notification shall be at a frequency designated by the State and shall continue until the maximum contaminant level has not been exceeded in two successive samples or until a monitoring schedule as a condition to a variance, exception or enforcement action shall become effective.

Nitrate sampling when maximum contaminant level exceeded. The sampling for nitrate is an exception to the procedure given above when the maximum contaminant levels are exceeded. When a level exceeding the maximum contaminant level for nitrate is found, a second analysis shall be initiated within 24 hours, and if the mean of the two analyses exceeds the maximum contaminant level, the supplier of water shall report this to the State and shall notify the public.

Data substitution. For the initial inorganic analyses required, data for surface waters acquired within one year prior to the effective date and data for ground waters acquired within three years prior to the effective date of the regulations may be substituted at the discretion of the State.

Turbidity Monitoring

For turbidity monitoring, samples must be taken in both community and non-community systems using a surface source at a representative entry point to the water distribution system at least once per day. Turbidity measurements must be made at the water treatment plant. In the event that a measurement indicates that the maximum allowable limit has been exceeded, the sampling and measurement must be repeated within one hour. If the repeat sample confirms that the maximum allowable concentration has been exceeded, these results are reported within 48 hours to the State. The repeat sample is used for monthly averages. If the monthly average of all samples exceeds the maximum allowable limit, or if the average of two samples taken on consecutive days exceeds 5 TU, this fact must be reported to the State and the public notified.

Organic Chemical Sampling

Surface water supplies. To establish an initial record of water quality with respect to these substances, an analysis must be completed for all community water systems utilizing surface water sources within one year after the effective date of the regulations. The samples shall be collected during the period of the year designated by the State as the period when contamination by pesticides is most likely to occur. These analyses shall be repeated at intervals specified by the State but not less frequently than at three year intervals.

Ground water supplies. For community water systems utilizing only ground water sources, analyses shall be completed by those systems specified by the State.

Sampling when organic maximum contaminant levels are exceeded. If the result of an analysis indicates that the level of any organic contaminant exceeds the maximum contaminant level, the supplier of water shall report to the State within 7 days and initiate three additional analyses within one month.

When the average of four analyses, rounded to the same number of significant figures as the maximum contaminant level for the substance in question, exceeds the maximum contaminant level, the supplier of water shall report to the State and give notice to the public. Monitoring after public notification shall be at a frequency designated by the State and shall continue until the maximum contaminant level has not been exceeded in two successive samples or until a monitoring schedule as a condition to a variance, exemption or enforcement action shall become effective.

Data substitution. For the initial organic analyses required data for surface water acquired within one year prior to the effective date of the regulations and data for ground waters acquired within three years prior to the effective date of the regulations may be substituted at the discretion of the State.

Basic Sampling Requirements for Coliform Density

Community systems. Samples for microbiological analyses are to be taken at regular intervals throughout the month proportional to the population served by the system as shown below. Samples should be collected from representative locations throughout the system.

Population Served	Minimum number of samples per month
25 to 1,000	1*
1,000 to 2,500	2
2,501 to 3,330	3
3,301 to 4,100	4
4,101 to 4,900	5
4,901 to 5,800	6
5,801 to 6,700	7

Population Served	Minimum number of samples per month
6,701 to 7,600	8
7,601 to 8,500	9
8,501 to 9,400	10
9,401 to 10,300	11
10,301 to 11,100	12
11,101 to 12,000	13
12,001 to 12,900	14
12,901 to 13,700	15
13,701 to 14,600	16
14,601 to 15,500	17
15,501 to 16,300	18
16,301 to 17,200	19
17,201 to 18,100	20
18,101 to 18,900	21
18,901 to 19,800	22
19,801 to 20,700	23
20,701 to 21,500	24
21,501 to 22,300	25
22,301 to 23,200	26
23,201 to 24,000	27
24,001 to 24,900	28
24,901 to 25,000	29
25,001 to 28,000	30
28,001 to 33,000	35
33,001 to 37,000	40
37,001 to 41,000	45
41,000 to 46,000	50
46,001 to 50,000	55
50,001 to 54,000	60
54,001 to 59,000	65
59,001 to 64,000	70
64,001 to 70,000	75
70,001 to 76,000	80
76,001 to 83,000	85
83,001 to 90,000	90
90,001 to 96,000	95
96,001 to 111,000	100
111,001 to 130,000	110
130,001 to 160,000	120
160,001 to 190,000	130
190,001 to 220,000	140
220,001 to 250,000	150
250,001 to 290,000	160
290,001 to 320,000	170
320,001 to 360,000	180
360,001 to 410,000	190
410,001 to 450,000	200
450,001 to 500,000	210

Population Served	Minimum number of samples per month
500,001 to 550,000	220
550,001 to 600,000	230
600,001 to 660,000	240
660,001 to 720,000	250
720,001 to 780,000	260
780,001 to 840,000	270
840,001 to 910,000	280
910,001 to 970,000	290
970,001 to 1,050,000	300
1,050,001 to 1,140,000	310
1,140,001 to 1,230,000	320
1,230,001 to 1,320,000	330
1,320,001 to 1,420,000	340
1,420,001 to 1,520,000	350
1,520,001 to 1,630,000	360
1,630,001 to 1,730,000	370
1,730,001 to 1,850,000	380
1,850,001 to 1,970,000	390
1,970,001 to 2,060,000	400
2,060,001 to 2,270,000	410
2,270,001 to 2,510,000	420
2,510,001 to 2,750,000	430
2,750,001 to 3,020,000	440
3,020,001 to 3,320,000	450
3,320,001 to 3,620,000	460
3,620,001 to 3,960,000	470
3,960,001 to 4,310,000	480
4,310,001 to 4,690,000	490
> 4,690,001	500

*Based on a history of no coliform bacterial contamination and on a sanitary survey by the State showing the water system to be supplied solely by a protected ground water source and free of sanitary defects, a community water system serving 25 to 1,000 persons, with written permission from the state, may reduce this sampling frequency except that in no case shall it be reduced to less than one per quarter.

Non-community systems. The supplier of water for a non-community water system shall sample for coliform bacteria in each calendar quarter during which the system provides water to the public. This sampling shall begin no later than June 1979, If the State, on the basis of a sanitary survey, determines that some other frequency is more appropriate, that frequency shall be the frequency required under these regulations. This frequency shall be confirmed or changed on the basis of subsequent surveys.

Check-sample requirements. When the coliform colonies in a single standard sample exceed four per 100 milliliters, additional daily samples must be collected and examined from the same sampling point until the results obtained from at least two consecutive samples show less than one coliform per 100 milliliters. When organisms of the coliform group occur in three or more 10 ml portions of a single standard sample, daily samples must be collected from the same sampling point until the results obtained from at least two consecutive samples show no positive tubes.

When organisms of the coliform group occur in all five of the 100 ml portions of a single standard sample, daily samples must be collected from the same sampling point until the results obtained from at least two consecutive samples show no positive tubes. The location at which a check sample is taken must not be eliminated from future sampling because of a history of questionable water quality. Check-samples are not included in calculating the total number of samples to be taken by a public supplier each month. Nor are they included in determining compliance with microbiological MCL's. When a particular sampling point has been confirmed by a check-sample to be in non-compliance with the maximum contaminant levels specified, the supplier of water must notify the state and make reports required by the regulations.

Check-sample reporting. When the presence of coliform bacteria in water taken from a particular sampling point has been confirmed by any check samples examined, the supplier of water shall report to the State within 48 hours.

Maximum contaminant level exceeded. When a maximum contaminant level is exceeded, the supplier of water shall report to the State and notify the public.

Substitution of residual chlorine for coliform measurement sampling. A supplier may, with the approval of the state and based on a sanitary survey, substitute the use of chlorine residual monitoring for up to 75 percent of the coliform samples required for the system. The supplier of water must take chlorine residual samples at points which are representative of the conditions within the distribution system at a frequency of at least four chlorine residuals for each substituted microbiological sample. There must be at least daily determinations of chlorine residual if a supplier exercises this option and he must maintain no less than 0.2 mg/l free chlorine in the water distribution system. When a particular sampling point has been shown to have a free chlorine residual less than 0.2 mg/l, the water at that location shall be retested as soon as practicable and in any event within one hour. If the original analysis is confirmed, this fact shall be reported to the State within 48 hours. Also, if the analysis is confirmed, a sample for coliform bacterial analysis must be collected from that sampling point as soon as practicable and preferably within one hour, and the results of such analysis reported to the State within 48 hours after the results are known to the supplier of water. Compliance with the maximum contaminant levels for coliform bacteria shall be determined on the monthly mean or quarterly mean basis including those samples taken as a result of failure to maintain the required chlorine residual level. The State may withdraw its approval of the use of chlorine residual substitution at any time.

Monitoring of Consecutive Public Water Systems

When a public water system supplies water to one or more other public water systems, the State may modify the monitoring requirements to the extent that the interconnection of the systems justifies treating them as a single system for monitoring purposes. Any modified monitoring shall be conducted pursuant to a schedule specified by the State and concurred in by the Administrator of the U.S. Environmental Protection Agency.

Reporting, Public Notification and Record Keeping

Reporting. Public water suppliers must report the results of these various analyses to the state within 40 days following the test, measurement or analysis. Public water suppliers must report the failure to comply with any primary drinking water regulation, including monitoring requirements, to the state within 48 hours.

Analytical results which are performed by State laboratories that report those results to the State Department responsible for drinking water need not be also reported by the public water supplier.

Reporting procedures for water samples exceeding maximum contaminant levels are discussed in the previous section on monitoring under each of the different analysis types.

Public notification.

Community water systems. If a community water system fails to comply with an applicable maximum contaminant level, fails to comply with an applicable analytical testing procedure, is granted a variance or an exemption from an applicable maximum contaminant level, fails to comply with the requirements of any schedule prescribed pursuant to a variance or exemption, or fails to perform any required monitoring, the supplier of water shall notify persons served by the system of the failure or grant by inclusion of a notice in the first set of water bills of the system issued after the failure or grant and in any event by written notice within three months. This notice shall be repeated at least once every three months for so long as the system's failure continues or the variance or exemption remains in effect. If the system issues water bills less frequently than quarterly, or does not issue water bills, the notice shall be made by or supplemented by another form of direct mail.

If a community water system has failed to comply with an applicable maximum contaminant level, the supplier of water shall notify the public of such failure, in addition to the notification required by the previous paragraph, as follows:

1. by publication on not less than three consecutive days in a newspaper or newspapers of general circulation in the area served by the system; such notice shall be completed within 14 days after the supplier of water learns of the failure;

2. by furnishing a copy of the notice to the radio and television stations serving the area served by the system;

such notice shall be furnished within seven days after the supplier of water learns of the failure; and

3. if the area served by a community water system is not served by a daily newspaper of general circulation, notification by newspaper required by paragraph (2) shall instead be given by publication on three consecutive weeks in a weekly newspaper of general circulation serving the area; if no weekly or daily newspaper of general circulation serves the area, notice shall be given by posting the notice in post offices within the area served by the system.

Non-community water systems. If a non-community water system fails to comply with an applicable maximum contaminant level, fails to comply with an applicable testing procedure, is granted a variance or an exemption from an applicable maximum contaminant levels, fails to comply with the requirement of any schedule prescribed pursuant to a variance or exemption or fails to perform any monitoring required, the supplier of water shall give notice of such failure or grant to the persons served by the system. The form and manner of such notice shall be prescribed by the State, and shall insure that the public using the system is adequately informed of the failure or grant.

Nature of notices. Notices given pursuant to this section shall be written in a manner reasonably designed to inform fully the users of the system. The notice shall be conspicuous and shall not use unduly technical language, unduly small print or other methods which would frustrate the purpose of the notice. The notice shall disclose all material facts regarding the subject including the nature of the problem and, when appropriate, a clear statement that a primary drinking water regulation has been violated and any preventive measures that should be taken by the public. Where appropriate, or where designated by the State, bilingual notice shall be given. Notices may include a balanced explanation of the significance or seriousness to the public health of the subject of the notice, a fair explanation of steps taken by the system to correct any problem and the results of any additional sampling.

State notification. Notice to the public required by this section may be given by the State on behalf of the supplier of water.

Exceptions. In any instance in which notification by mail is required but notification by newspaper or to radio or television stations is not required, the State may order the supplier of water to provide notification by newspaper and to radio and television stations when circumstances make more immediate or broader notice appropriate to protect the public health.

Record keeping. Any owner or operator of a public water system subject to the provisions of this part shall retain on its premises or at a convenient location near its premises the following records.

1. Records of bacteriological analyses shall be kept for not less than 5 years. Records of chemical analysis shall be kept for not less than 10 years. Actual laboratory reports may be kept, or data may be transferred to tabular summaries, provided that the following information is included:

    a. the date, place, and time of sampling, and the name of the person who collected the sample;

    b. identification of the sample as to whether it was a routine distribution system sample, check sample, raw or process water sample or other special purpose sample;

c. date of analysis;

d. laboratory and person responsible for performing analysis;

e. the analytical technique/method used; and

f. the results of the analysis.

2. Records of action taken by the system to correct violations of primary drinking water regulations shall be kept for a period not less than three years after the last action was taken with respect to the particular violation.

3. Copies of any written reports, summaries, or communications relating to sanitary surveys of the system conducted by the system itself, by a private consultant, or by any local, State or Federal agency, shall be kept for a period not less than 10 years after completion of the sanitary survey.

4. Records concerning a variance or exemption granted to the system shall be kept for a period of not less than five years following the expiration of such variance or exemption.

Summary of Inorganic and Organic Sampling and Analytical Requirements

The following two tables give a summary of sampling and analytical requirements for inorganic and organic contaminants.

Table 7

Inorganic Chemical Sampling and Analytical Requirements

- Community

Surface Source Initial Sampling	within 1 year EDR
Ground Source Initial Sampling	within 2 years EDR
Surface Source Monitoring	yearly
Ground Source Monitoring	every 3 years

- Non-Community

Surface or Ground (Nitrates only)	
Initial Sampling	within 2 years EDR
Monitoring	as specified by state

Table 8

Organic Chemical Sampling and Analytical Requirements

- Community

Surface Source Initial Sampling	within 1 year EDR
Ground Source Initial Sampling	as specified by state
Surface Source Monitoring	every 3 years
Ground Source Monitoring	as specified by state

- Non-Community

Surface or Ground Source	
Initial Sampling	no requirement
Monitoring	no requirement

ANALYTICAL TECHNIQUES

The regulations specify analytical procedures for each of the maximum contaminant levels. These procedures will be updated as improvements are made in analytical methods. As an example, Standard Methods for the Examination of Water and Wastewater is referenced repeatedly in the specific procedures sections which follow. When the current 13th Edition is supplanted by the 14th Edition, the references will be changed to reflect the latest edition.

In the following sections are listed the required analytical methods.

Inorganic Chemical Analysis

Analyses conducted to determine compliance with inorganic maximum contaminant levels shall be made in accordance with the following methods.

Arsenic. Atomic Absorption Method, Methods for Chemical Analysis of Water and Wastes, pp. 95-96, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

Barium. Atomic Absorption Method, Standard Methods for the Examination of Water and Wastewater, 13th Edition, pp. 210-214, or Methods for Chemical Analysis of Water and Wastes, pp. 97-98, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

Cadmium. Atomic Absorption Method, Standard Methods for the Examination of Water and Wastewater, 13th Edition, pp. 210-215, or Methods for Chemical Analysis of Water and Wastes, pp. 101-103, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

Chromium. Atomic Absorption Method, Standard Methods for the Examination of Water and Wastewater, 13th Edition, pp. 210-215, or Methods for Chemical Analysis of Water and Wastes, pp. 105-106, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

Lead. Atomic Absorption Method, Standard Methods for the Examination of Water and Wastewater, 13th Edition, pp. 210-215, or Methods for Chemical Analysis of Water and Wastes, pp. 112-113, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20450, 1974.

Mercury. Flameless Atomic Absorption Method, Methods for Chemical Analysis of Water and Wastes, pp. 118-126, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

Nitrate. Brucine Colorimetric Method, Standard Methods for the Examination of Water and Wastewater, 13th Edition, pp. 460-464, Cadmium Reduction Method, Methods for Chemical Analysis of Water and Wastes, pp. 201-206, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

Selenium. Atomic Absorption Method, Methods for Chemical Analysis of Water and Wastes, p. 145, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20450, 1974.

Silver. Atomic Absorption Method. Standard Methods for the Examination of Water and Wastewater, 13th Edition, pp. 310-315, or Methods for Chemical Analysis of Water and Wastes, p. 146, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

Fluoride. Electrode Method, Standard Methods for the Examination of Water and Wastewater, 13th Edition, pp. 172-174, or Methods for Chemical Analysis of Water and Wastes, pp. 65-67, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974, or Colorimetric Method with Preliminary Distillation, Standard Methods for the Examination of Water and Wastewater, 13th Edition, pp. 171-172 and 174-176, or Methods for Chemical Analysis of Water and Wastes, pp. 59-60, Environmental Protection Agency, Office of Technology, Transfer, Washington, D.C. 20460, 1974.

Turbidity

The measurement shall be made by the Nephelometric Method in accordance with the recommendations set forth in Standard Methods for the Examination of Water and Wastewater, American Public Health Association, 13th Edition, pp. 350-353, or Methods for Chemical Analysis of Water and Wastes, pp. 295-298, Environmental Protection Agency, Office of Technology Transfer, Washington, D.C. 20460, 1974.

Organics

Analyses made to determine compliance with maximum contaminant levels of Chlorinated Phenoxy Acid Herbicides shall be conducted in accordance with Methods for Chlorinated Phenoxy Acid Herbicides in Industrial Effluents, MDQARL, Environmental Protection Agency, Cincinnati, Ohio, November 28, 1973.

Analyses made to determine compliance with maximum contaminant levels of Organochlorine pesticides shall be made in accordance with Method for Organochlorine Pesticides in Industrial Effluents, MDQARL, Environmental Protection Agency, Cincinnati, Ohio, November 28, 1973.

Microbiological Analytical Methods

Suppliers of water for community water systems and non-community water systems shall analyze for coliform bacteria for the purpose of determining compliance with maximum microbiological contaminant levels. Analyses shall be conducted in accordance with the analytical recommendations set forth in Standard Methods for the Examination of Water and Wastewater, American Public Health Association, 13th Edition, pp. 662-688, except that a standard sample size shall be employed. The standard sample used in the membrane filter procedure shall be 100 milliliters. The standard sample used in the 5 tube most probable number (MPN) procedure (fermentation tube method) shall be 5 times the standard portion. The standard portion is either 10 milliliters or 100 milliliters.

Alternative Analytical Techniques

With the written permission of the State, concurred in by the

Administrator of the U.S. Environmental Protection Agency, an alternative analytical technique may be employed. An alternative technique shall be acceptable only if it is substantially equivalent to the prescribed test in both precision and accuracy as it relates to the determination of compliance with any maximum contaminant level. The use of the alternative analytical technique shall not decrease the frequency of monitoring.

Approved Laboratories

Clearly, a critical component of the development of safe drinking water supplies nationwide is reliable laboratory analyses. In section 141.28 of the regulations, it is stated that samples will be considered only if they have been analyzed by a laboratory approved by the State (except that free chlorine and turbidity can be performed by anyone acceptable to the State). Previously, EPA, in cooperation with interested parties, was developing criteria and procedures for laboratory certification. It is intended that a state will have a laboratory certified by the EPA. Subsequently, this laboratory could certify other laboratories within the state.

Sampling Summary

A summary of the various sampling technique requirements described in specific analytical procedures is given in Table 4 on the following page. Also presented is a summary of information concerning analytical methods in Table 5.

Table 9

Standard Methods Sampling Requirements[a]

Analysis	Sample Volume Required	Sample Container	Preservative	Maximum Sample Holding Period
Bacteriological	100 ml minimum	Sterilizable glass or plastic	Cool, 4°C, (100 ppm sodium thiosulfate)[b]	30 hours
Trace Metals (total)	100 ml	Plastic or glass	HNO_3 to pH<2	6 months
Arsenic	"	"	"	"
Barium	50 ml	"	"	"
Cadmium	"	"	"	"
Chromium	"	"	"	"
Lead	"	"	"	"
Mercury	"	"	"	"
Selenium	"	"	"	"
Silver	"	"	"	"
Fluoride	300 ml	"	Cool, 4°C	7 days
Nitrate	100 ml	"	Cool, 4°C, H_2SO_3 to pH<2[c]	24 hours
Turbidity	100 ml	"	Cool, 4°C	7 days
Pesticides	One gallon	Glass only (Teflon-lined cap)	Refrigerated on receipt at lab[d]	7 days Herbicide 14 days Chlor HC
Chlorine Residual	100 ml	Plastic or glass	Avoid excessive light and agitation	no storage
Radioactive	One gallon	Hard Polyethylene recommended	10% HNO_3[e]	immediate for avoidance of sorption

[a]REFERENCE: <u>Methods for Chemical Analysis of Water and Wastes</u>, pp. vi-xii.

[b]Dechlorination agent (Chelation agents should be considered in waters high in copper or zinc).

[c]Mercuric chloride may be used as an alternative preservative at a concentration of 40 mg/l for longer maximum sample holding period. This procedure is discouraged.

[d]March 1976, EPA viewpoint.

[e]No acidification for specific analysis requiring neutrality (e.g., iodine, tritium, C^{14}, etc.).

Table 10

Analytical Methods Description for Contaminants[a]

Contaminant		Analytical Method	Instrument	Detection Limit mg/l	Sensitivity mg/l	Optimum Concentration Range Max. mg/l	Optimum Concentration Range Min. mg/l	Cost $/Analysis
Bacteriological		Membrane Filter or MPN	None	----	----	----	----	5.00
Trace Metals								
Arsenic		Silver Diethyldithiocarbonate (Gaseous Hydride)	Atomic Absorption	0.002	----	0.02	0.042	9.00
Barium		Atomic Absorption	Atomic Absorption	0.03	0.04	20	1	6.00
Cadmium		"	"	0.002	0.025	2	0.05	6.00
Chromium		"	"	0.02	0.01	10	0.2	6.00
Lead		"	"	0.05	0.05	20	1	6.00
Mercury		"	"	0.0002	----	0.01	0.0002	10.00
Selenium		"	"	0.002	----	0.02	0.002	9.00
Silver		"	"	0.01	0.06	4	1	6.00
Fluoride	or	SPADNS/Distillation	-----			2.5	1	4.50
		Electrode Method	pH meter			1000	0.1	4.50
Nitrate	or	Cadmium Reduction	Spectrophotometer			1.0	0.01	4.00
		Brucine Colorimetric	Spectrophotometer			2.0	0.01	
Turbidity			Turbidimeter			40	0 NTU	2.75
Pesticides			Gas chromatograph	ppt				100.00
Chlorine Residual		DPD Colorimetric	Field Test Kit					.05
Radioactive		See Appendix on Radioactive Regulations						

[a]References: Methods for Chemical Analysis of Water and Wastes
Handbook for Evaluating Water Bacteriological Laboratories
Mr. Earl McFarren, Mr. Herman Krieger, EPA Monitoring and Support Laboratory, Cincinnati

Sampling Considerations

It is well known that the quality of analysis is dependent on both laboratory technique and sampling procedures. Errors associated with sampling are much greater than those associated with laboratory analysis. In addition to the information described above in Table 5, the following information is presented for improved sampling techniques.

Bacteriological sampling. Proper consideration should be given to: (a) sample bottle preparation, (b) the taking of the sample, and (c) the transport of sample to the laboratory. An excellent reference on these topics is Geldreich's Handbook for Evaluating Water Bacteriological Laboratories (EPA-670/9-75-006, August 1975).

Sample bottle preparation. Sample bottles may be of any size or shape if properly sterilized and of sufficient volume. The most desirable sample bottles are wide-mouth bottles since this type lessens the possibility of accidental contamination. Glass bottles should be noncorrosive (e.g. borosilicate) and metal or plastic screw caps should have a nontoxic, leakproof liner. Ground glass stoppers and necks should be covered with paper, rubberized cloth, or metal foil before sterilization. These covers protect against contamination prior to sampling. Autoclavable plastic bottles provide an acceptable sample container. It is recommended that both the bottle and cap be of the same plastic material to decrease sample leaking on refrigeration. Advantages of plastic bottles are their lightweight and breakage resistant characteristics.

Taking the water sample. The minimum number of samples to be taken each month is a function of the population served by the water supply and has been defined previously in this manual. It is reemphasized that these samples should be collected at representative points throughout the distribution system. It is important that the sampling locations be sufficiently uniform so that the possibility of localized undetected contaminations through cross-connections, breaks in distribution lines, or inadequate pressure is minimized.

The following steps are recommended for the actual taking of the sample:

1. Select taps for samples which are served by a distribution water main (rather than a storage tank).

2. The sample tap must allow sampling without touching the neck of the sample bottle to the tap (avoid taps close to the ground or bottom of sink).

3. Avoid taps which leak around valve stem.

4. Remove tap attachments before sampling (e.g. aerators).

5. The selected tap should be a cold water tap. An even flow of water should be permitted for two to three minutes prior to sampling. Avoid a splashing flow.

6. After removing bottle top continue to hold the top; do not put it down. Do not touch the inside of the cap. Do not permit the tap to touch the bottle. Do not adjust stream flow during sampling.

7. Allow the bottle to fill within on inch of the top, then cap the bottle. Last of all, turn off the tap.

8. Label the sample as to time and date, sample location, field tests, and sample collector's identity.

9. Geldrich in his Handbook does not recommend flaming the tap; he does recommend selectivity in choosing a sample tap.

Samples containing chlorine must be dechlorinated at the time of collection to prevent elimination of an existing contamination. Sufficient sodium thiosulfate is added to sample bottles prior to sterilization so that the addition of the water sample volume will result in 100 ppm concentration.

Transport of sample. It is preferable that the transport time of the water sample to the laboratory should not exceed 30 hours. The sample should be refrigerated. Samples held longer than a 30-hour period will be subject to increasingly unpredictable bacterial densities.

Chemical sampling. Sampling, preservation and storage for chemical analysis is more varied than bacteriological sampling because of the greater number of different types of tests which must be run. Specific sampling and preservative information for individual analyses is listed in the referenced analytical procedures and summarized in the table on this topic. There are some general guidelines which are helpful in obtaining more consistent results--particularly when dealing with trace concentrations. In the determination of trace concentrations loss and addition of contaminant are major problems. An identical contaminant located in the sampling or laboratory environment can radically increase the sample concentration. Containers which adsorb contaminants can substantially reduce concentrations of the contaminant in the water sample prior to analysis.

It is recommended that for trace metal analysis that the sample bottles be sequentially washed with detergent and tap water, rinsed with 1:1 nitric acid, tap water, hydrochloric acid, tap water, and deionized distilled water. Chromic acid is often used to cleanse organics from glassware. Special rinsing of such glassware should be done if this glassware is to be in chromium determinations. Use of Chromic acid with plastic bottles should be avoided.

In radioactive sampling it should be again emphasized that the low concentrations being measured increase the importance of precise sampling and analytical techniques. The microgram quantities of radioactive materials increase the possibility of loss of the sample by sorption into the container surface or into suspended particles in the waste sample. The recommended procedure for radioactive sample bottles is one-time-use. Preservatives should be avoided prior to separation into soluble and suspended components since they may cause a change in the homogeneity of the sample.

For pesticide sampling the sample bottle may be reused by using the following cleasing procedure:

1. wash with detergent for normal cleansing,
2. rinse with tap water and then distilled water, and
3. either rinse with acetone and air dry or dry in a muffle furnace at 400 degrees for one-half hour.

It should be noted that EPA is presently developing criteria for certification of potable water laboratories to comply with the requirements of the Safe Drinking Water Act. It is expected that these criteria will be published in the Federal Register in September of 1976, and that supplementary and additional specific chemical sampling techniques will be included.

SANITARY SURVEYS

Sanitary surveys are an important component of any program to maintain a safe public drinking water supply. It is believed that these surveys are more effective in assuring safe drinking water than are individual tests in the absence of sanitary surveys. The definition of sanitary surveys contained in the regulations reflects their broad nature--including on-site review of the water source, facilities, equipment, operation and maintenance of a public water system.

Principle

The guiding principle of a sanitary survey, as given by the 1962 Public Health Service Drinking Water Standards, is that it shall be made frequently to identify and locate health hazards which might exist in the system.

Evaluation of Water System

A satisfactory evaluation of a water supply system necessitates a study of the water source and the operating practices and safeguards used. The EPA Manual for Evaluating Public Drinking Water Supplies (EPA-430/0-75-011) lists the following points which should be in such a study:

> ....(a) a field and office sanitary survey of the water and its environment from source to the consumer's tap;
>
> (b) a description of the water system's physical features including adequacy of supply, treatment processes and equipment, storage facilities, and delivery capabilities (sketches are invaluable);

(c) an analysis of 12-month bacterial records and current chemical records on water from the source, the treatment plant, and the distribution system;

(d) an analysis of operating records showing present capacity, water demands, production to meet demands, and anticipated future demands;

(e) a review of management and operation methods and of the training, experience, and capabilities of personnel;

(f) a review of treatment plant and supporting laboratory equipment and procedures, including the qualifications of the laboratory personnel;

(g) an examination of state and local regulations and plumbing codes; and

(h) a summary and analysis of all facts pertinent to all water-system-related health hazards that were observed during a field survey.

Survey Engineer

Since the competence of the individual making the survey determines the quality of the survey, it is clear that the best qualified individual should be selected. The EPA Manual for Evaluating Drinking Water Supplies describes his characteristics as follows:

> Although the qualifications constituting competence cannot be precisely defined, he should have a technical education in basic sanitary sciences and engineering and a broad knowledge of sanitary features and physical facts concerning potable water supplies and their sources. The essential features of water purification plants and systems, including their operations and methods of laboratory control, must also be understood by the investigator.

Survey Report

A water supply system should provide continuously a safe drinking water to its consumers. The survey report addresses this capability of the water supply system. The reliability of the water source, the effectiveness of the treatment plants, the capability of the distribution system to meet normal and peak demands while maintaining satisfactory water pressure should be assessed by the engineer.

Sanitory surveys should be conducted sufficiently frequently to control health hazards. Survey reports should be revised annually and updated as is indicated by operating conditions or data.

A description of the physical features of the water supply system should be included in the survey report. This description should be inclusive of the system from water source to tap, appropriately using sketches and maps, and include:

1. the name and owner of the supply;
2. a source and catchment description;
3. system storage; and
4. a water supply system construction history.

APPENDIX A

Maximum Contaminant Levels for Radioactivity

On December 24, 1975, the United States Environmental Protection Agency published the "National Interim Primary Drinking Water Regulations." A part of the regulations was the "water standards" or the maximum contaminant levels. Not included in the list of published maximum contaminant levels were standards on radioactivity, even though "Proposed Maximum Contaminant levels for Radioactivity" had been published in the Federal Register on August 14, 1975. These radioactivity maximum contaminant levels will be added to the list of the National Interim Primary Drinking Water Regulations during the first half of 1976. Spokesmen for EPA have stated that the radioactivity regulations will have the same effective date, June 24, 1977, as the earlier published regulations. The draft form of the interim primary drinking water regulations on radioactivity is summarized in this Appendix. Essentially, the draft form of the interim regulations was not changed from the proposed regulations. It is emphasized that this section is based on draft regulations which may well be further modified.

Scope of Problem

The two potential sources of radioactivity in water supplied are of two types: (1) naturally occurring and (2) man-made. Radium 226 is the primary radioisotope of concern in naturally occurring radioactivity and is normally found in ground water resources. Man-made radioactivity normally originates in surface water supplies with deposition of Strontium-90 and tritium from atmospheric nuclear testing the most important source. EPA observed that the national use of radionuclides in medicine, industry, and power generation will unavoidably lead to radioactivity entering the aquatic environment. EPA further recognized that any dose of ionizing radiation has the potential for producing deleterious health effects; thus, EPA proposed maximum contaminant levels for radioactivity. These levels were proposed based on the assumptions that detrimental health effects are proportional to the dose received and that a human will drink two liters of water per day.

Maximum Contaminants Levels

Section 141.15 and 141.16 of the regulations established the following maximum contaminant levels as seen in Table 11.

Table 11

Maximum Contaminant Levels for Radioactivity

Contaminant	Level
Combined Radium-226 and Radium-228	5 picocuries per liter
Gross alpha particle activity (including Radium-226)	15 picocuries per liter
Beta Particle and photon radioactivity from man-made radionuclides	Annual dose equivalent to the total body or any internal organ not to exceed 4 millirems

Compliance with Maximum Contaminant Levels

Gross alpha, Radium-226 and 228. A gross alpha screening level of 5 picocuries per liter has been established as being capable of assuring compliance with both the combined radium and the gross alpha levels, provided that the measured gross alpha particle activity does not exceed a confidence level of 95% (1.65 times the standard deviation of the net counting rate of the sample).

If the 5 picocuries per liter value is exceeded then an equivalent sample is to be analyzed for Radium 226. If this sample exceeds a concentration of 3 picocuries per liter, then an equivalent sample is to be analyzed for Radium-228.

Gross beta and photon radioactivity. Compliance with this maximum contaminant level may be assumed if:

1. there is a gross beta particle activity of less than 50 picocuries per liter and if

2. the average annual concentration of tritium in the total body is less than 20,000 picocuries per liter and an average annual concentration of Strontium-90 in the bone marrow of 8 picocuries per liter, provided that

3. if both radionuclides are present the sum of the annual dose equivalent to the bone marrow does not exceed 4 millirems.

If the gross beta particle activity exceeds 50 picocuries per liter, an analysis of the sample must be performed to identify the major radioactive constituents present and the appropriate organ and total body doses shall be calculated.

Monitoring Requirements

Gross alpha particle radioactivity. In order to determine compliance with these maximum contaminant levels community water supplies are required to monitor gross alpha particle radioactivity within two years of the effective date of regulations (June 24, 1977). The analysis is to be made for an annual composite of four quarterly samples or four individually analyzed, quarterly samples. If any of the various screening levels are surpassed, the same monitoring frequency is applicable to radium determinations. If a maximum contaminant level is exceeded, monitoring is to continue at quarterly intervals until the annual average meets the standard. Repeat monitoring of four quarterly composite or four individual quarterly samples is to be performed every four years for either groundwater or surface water.

Gross beta particle activity. In order to determine compliance with these maximum contaminant levels community water suppliers serving more than 100,000 persons and other community water systems designated by the state are required to monitor beta particle activity within two years of the effective date of regulations (June 24, 1977).

The analyses are to be performed upon a composite of four quarterly samples or four individual quarterly samples. If a maximum contaminant level is exceeded, analyses are to be repeated upon monthly or composite quarterly samples. For systems not exceeding maximum contaminant levels, monitoring is to be repeated every four years.

Water supplies affected by nuclear facility effluents. Within two years of the effective date of these regulations (June 24, 1977), monitoring is required on a quarterly basis for iodine-131 radioactivity and monitoring is required on an annual basis for tritium and strontium-90 in any community water system utilizing waters affected by effluents from nuclear facilities. Gross beta particle activity shall be based on analysis of monthly samples or composites of three montly samples. If the gross beta particle activity in a sample exceeds 15 picocuries per liter, an equivalent sample shall be analyzed for strontium-89 and cesium-134. If the maximum contaminant level based on an average annual concentration is exceeded, then the operator of a community water system is to give public notice and monitoring is to be continued with monthly samples or the analyses of quarterly compositles of three monthly samples until compliance is achieved. Substitution of discharge data from nuclear facilities for direct monitoring of man-made radioactivity by the supplier of water may be allowed if reasonable.

Exceptions. The monitoring requirements apply only to community water systems. Suppliers of water whose sole source of water is ground water are not required to monitor for man-made radioactivity. The enforcing agency may require special monitoring if the situation requires this action.

Analytical Methods for Radioactivity

Gross alpha and beta. Method 302 "Gross Alpha and Beta Radioactivity in Water," Standard Methods for the Examination of Water and Wastewater 13th Edition, American Public Health Association, New York, N.Y., 1971.

Total radium. Method 304 "Radium in Water by Precipitation," same source as above.

Radium-226. Method 305 "Radium-226 by Radon in Water," same source as above.

Strontium-89, 90. Method 303 "Total Strontium and Strontium-90 in Water," same source as above.

Tritium. Method 306 "Tritium in Water," same source as above.

Cesium-134. ASTM D-2459 "Gamma Spectrometry in Water," 1975 Annual Book of ASTM Standards, Water and Atmospheric Analysis, Part 31, American Society for Testing and Materials (1975).

Uranium. ASTM D-2907 "Microquantities of Uranium in Water by Fluorometry," 1975 Annual Book of ASTM Standards, Water and Atmospheric Analysis. Part 31, American Society for Testing and Materials (1975).

Substitute Methods. Equivalent analytical methods can be substituted with the approval of the state and EPA.

Other Radionuclides. Specific references are spelled out for radionuclides other than those listed above.

Detection Limits for Specific Radionuclides

The detection limits for specific radionuclides is given in the Table 12 below.

Table 12

Detection Limits for Man-made Beta Particle and Photon Emitters

Radionuclide	Detection limit
Tritium	1,000 pCi/l
Strontium-89	10. pCi/l
Strontium-90	2. pCi/l
Iodine-131	1. pCi/l
Cesium-134	10. pCi/l
Gross beta	4 pCi/l
Other radionuclides	1/10 of the applicable limit.

These detection limit values are important since laboratories not having sophisticated equipment will need to process larger water samples to concentrate the radionuclides.

Cost of Analyses

Estimated costs of analyses are given below in Table 13. These costs are for analyses only and do not include costs associated with sample collection and shipping.

Table 13

Radioactivity Analyses Costs[1]

Type of Analyses	Cost, $/Analysis
Gross alpha	10
Gross beta	10
Tritium	8
Iodine-131	15
Cesium-134 (1)	
Strontium-89	50
Strontium-90 (2)	
Radium-226	30
Radium-228	40

(1) Cost included with Iodine-131 analyses
(2) Cost included with Strontium-89

It is noted that the impact of these costs is likely to be largest on small communities with radioactive groundwater supplies.

(1) Reference: "Quantification of Specific Radionuclides Required Under New Regulations," by L. E. Priester, H. G. Shealy, and Stephen Barnwell.

DEFINITIONS

Dose equivalent . . . . means the product of the absorbed dose from ionizing radiation and such factors as account for differences in biological effectiveness due to the type of radiation and its distribution in the body as specified by the International Commission on Radiological Units and Measurements (ICRU).

Rem . . . . means the unit of dose equivalent from ionizing radiation to the total body or any internal organ or organ system. A "millirem (mrem)" is 1/1000 of a rem.

Picocurie (pCi) . . . . means that quantity of radioactive material-producing 2.22 nuclear transformations per minute.

Gross alpha particle activity . . . . means the total radioactivity due to alpha particle emission as inferred from measurements on a dry sample.

Man-made beta particle and photon emitters . . . .means all radionuclides emitting beta particles and/or photons listed in Maximum Permissible Body Burdens and Maximum Permissible Concentration of Radionuclides in Air or Water for Occupational Exposure.

APPENDIX B

Elements of Draft Versions of Underground

Injection Regulations

APPENDIX B

ELEMENTS OF DRAFT VERSIONS OF UNDERGROUND INJECTION REGULATIONS

Introduction

EPA has prepared and circulated a number of different draft-versions of potential underground injection control (UIC) regulations for review. The following sections contain some of the more important elements from a late April 1976 draft of the UIC regulations.

Definitions

Annular Injection

Annular injection means any injection through the annular space between the surface casing and the next inner casing of a drilled well, between the conductor casing and the surface casing, or between the out casing and the hole.

Aquifer

Aquifer means a formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells or springs.

Underground Injection

Underground injection means subsurface emplacement of fluids by well injection.

Fluid

Fluid means material which flows or moves, whether semi-solid, liquid, sludge, or any other form or state.

Well Injection

Well injection means subsurface emplacement through a bored, drilled, or driven well, or through a dug well where the depth is greater than the largest surface dimension, whenever a principal function of the well is the subsurface emplacement of fluids.

Surface Impoundment

Surface Impoundment means any dug well which has a depth less than the greatest surface dimension and is used for collection, storage, treatment, or disposal of fluids.

Underground Injection

Underground injection endangers underground drinking water sources if (1) such injection may make it necessary for a public water system using an underground drinking water source to increase treatment of the water, or (2) if such injection might make it necessary for a public water system which uses the source in the future to use more extensive treatment of the water than would otherwise have been necessary, or (3) if such injection may other wise adversely affect the health of persons such as by adding a substance that would make water from the source unfit for human consumption.

Aquifers To Be Protected

The underground injection control regulations are designed to prevent significant degradation of an underground drinking water source. An underground drinking water source means an aquifer which contains water having less than 10,000 mg/l total dissolved solids. An aquifer having water with less than 10,000 mg/l need not be protected if a state can demonstrate that the aquifer is not a potential source for a public water system because the aquifer is oil-producing, is too contaminated for use as a drinking water supply, or is in a location which makes future use of the aquifer as a drinking water supply impracticable.

Duration And Renewal of Permits

No underground injection control (UIC) permit may be issued for a term greater than five years. Upon a request to EPA, a permit may be renewed without requiring a formal reapplication by the permittee if the continued operation of the underground injection will not endanger a source of drinking water. If EPA determines that the continued operation may endanger an underground source, EPA may require the permittee to submit information to demonstrate the contrary. EPA must refuse to reissue the permit if the operator of the facility fails to prove his case.

Underground Injection From Disposal Wells

Certain types of underground injection must be under a permit system. Conventional waste disposal wells, engineering wells such as subsidence control wells, barrier wells, recharge wells, mining wells, storage wells, and geothermal wells fall into the category of requiring UIC permits and may be called disposal wells.

Five-Year Operation of Existing Disposal Wells Under A Rule Process

Underground injections that were in operation under an existing state program prior to EPA approval of the state UIC program, may continue to operate for a period of up to five years under a "regulated-by-rule" provision if the operation does not endanger underground drinking water sources. At the end of the five year period a UIC permit must be obtained. An application must be filed for each existing underground injection that is to continue in operation and EPA will systematically review each to determine that it does not endanger an underground drinking water source. Underground injections that are found to endanger a source must be discontinued or remedial action taken. If discontinuance is ordered, the well must be plugged and abandoned.

Requirement For Applications for UIC Permit For Disposal Wells

All new disposal wells, all existing disposal wells not operated under a state program, and all existing disposal wells that have operated for five years under a state rule-process must be given a UIC permit or cease operations. Each application for a UIC permit must include the following information.

(a) Ownership and Location Data
The application shall identify the owner and operator of the proposed underground injection facility, and the location of the facility.

(b) An accurate map showing location and surface elevation of the injection facility, property boundaries, and surface and mineral ownership.

(c) An accurate map showing the location of: water wells; surface bodies of water; oil, gas, exploratory or test wells (with depths of penetration); mines (surface and subsurface) and quarries; and other pertinent surface features including residences, roads, bedrock outcrops, and faults and fractures within a two mile radius of the injection facility.

(d) A tabulation of all wells requested under (c) penetrating the proposed injection zone, showing operator; lease or owner; well number; surface casing size and weight, depth and cementing data; intermediate casing size and weight; depth and cementing data; long string size and weight, depth and cementing data; and plugging data.

(e) Maps and cross section indicating the vertical and lateral limits of aquifers containing 3,000 and 10,000 mg/l TDS water quality levels, and direction of movement of the water in every underground drinking water source which may be affected by the proposed injection.

(f) Maps and cross sections detailing geologic structure for the local area and generalized maps and cross sections illustrating the regional geologic setting.

(g) Description of chemical, physical, and biological properties and characteristics of the fluid to be injected.

(h) Volume, injection rate and injection pressure of the fluid to be injected.

(i) The following geological and physical characteristics of the injection interval and the overlying and underlying confining beds:

(1) thickness;

(2) areal extent;

(3) lithology;

(4) location, extent and effects of known or suspected faulting, fracturing and natural solution channels;

(5) formation fluid chemistry, including total dissolved solids; and

(6) fracturing gradients.

(j) The following engineering data:

(1) diameter of hole and total depth of the well;

(2) type, size, weight, and strength of all casing strings;

(3) proposed cementing procedures and type of cement;

(4) proposed formation testing program;

(5) proposed stimulation program;

(6) proposed injection procedure;

(7) plans of the surface and subsurface construction details of the system including engineering drawings;

(8) plans for monitoring both well head and annular fluid pressure, fluids being injected in injection zone and other aquifers;

(9) expected changes in pressure, native fluid displacement and direction of movement of injection fluid; and

(10) contingency plans to cope with all shut-ins or well failures to prevent endangerment of underground drinking water sources.

(k) A written evaluation of alternative disposal practices in terms of maximum environmental protection.

Requirements For Disposal Wells

Underground injection by industrial and municipal waste disposal wells, subsidence control wells, barrier wells, recharge wells, mining wells, storage wells and geothermal wells are subject to the following requirements:

(a) that all underground drinking water sources of 3,000 mg/l total dissolved solids or less are protected by casing cemented to the surface; except where a lesser degree of protection has been demonstrated by compelling evidence to be sufficient to protect an underground drinking water source;

(b) that the long string is cemented with sufficient cement to fill the annular space to a height above the injection zone adequate to assure that upward migration of fluid cannot occur;

(c) that injection is maintained through tubing with a suitable packer set immediately above the injection zone;

(d) that there are no leaks in the system;

(e) that surface injection pressure is limited to preclude the possibility of fracturing the formation;

(f) that all well completion and plugging reports for wells penetrating the proposed in section zone within a two mile radius of the proposed well injection have been thoroughly reviewed to insure that all wells are properly completed and/or plugged so not to present a potential threat to underground drinking water sources; and

(g) that annular injection is not practiced.

Permits For Injection Wells Related To Oil or Gas Production

Eventually all injection wells related to oil or gas production must be operated under a permit. A permit must be obtained prior to operation of a new well, but an existing well may be operated for a period of five years after approval of a state program under a "regulated-by-rule" process. The same basic requirements and restrictions apply to injection wells related to oil or gas production as those outlined above for disposal wells.

The information required for a permit for a new oil or gas production related injection well is quite demanding and will be very costly to develop. The information required for permitting an existing injection well is more relaxed in that:

(1) EPA need only receive those data listed for a new injection well that is necessary to make the determination that an underground source of supply will not be endangered; and

(2) after review, if it is found that the existing injection does not endanger an underground drinking water source, the well may continue to operate under a permit.

Requirements Applicable To All Drainage Wells

Underground injections to dispose of storm water runoff, irrigation return-flow and excess ponded-surface waters may be regulated by rule or by permit system at the option of the state.

Regulation By Permit

If a state elects to regulate a drainage well by the permit, it must include, as a minimum:

(a) that the applicant provide information regarding location and design of the facility, nature and volume of the fluid to be injected, and such other information as may be necessary to satisfy the state that the underground injection will not endanger underground drinking water sources;

(b) that opportunity for public notice, comment and formal public hearing be provided in cases where EPA determines that the application raises substantial question of possible endangerment of underground drinking water sources; and

(c) that permits issued will be conditioned on compliance with specified inspection, monitoring, record-keeping and reporting requirements.

Regulation By Rule

If a state elects to regulate drainage wells by rule, the state regulations shall provide, but not be limited to, the following;

(a) that no injection that endangers an underground drinking water source be authorized;

(b) that a mechanism be provided for determining the nature and extent of the underground injection activity in the state;

(c) that a mechanism for insuring that periodic testing is conducted and that test-records are maintained in appropriate cases; and

(d) that design, location or construction of underground injection facilities that would be inconsistent with good practice for the protection of underground drinking water sources be prohibited.

HEALTH AND THE SAFE DRINKING WATER ACT

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Public Law 93-523, the Safe Drinking Water Act, requires the U.S. Environmental Protection Agency (EPA) to promulgate several types of drinking water regulations. The first is called the National Interim Primary Drinking Water Regulations. These interim regulations were published in the Federal Register on Dec. 24, 1975, and will take effect nationwide on June 24, 1977. These regulations are termed "interim" because the act also provides for a study by the National Academy of Sciences (NAS) of drinking water contaminants, and requires the interim regulations to be modified -- if necessary -- as a result of that study. The modified regulations will then be termed the Revised National Primary Drinking Water Regulations. The NAS study is currently underway. By either name, interim or revised, the primary regulations are to be nationally applicable and are to address matters of health. Since some contaminants of drinking water are undesirable for reasons other than health, such as iron and manganese and their attendant problems of staining, the act provides also for National Secondary Drinking Water Regulations. EPA is in the process of preparing these regulations at the present time. I have a copy of some of the material proposed for the secondary standards and will comment later. However, I would like to observe at this point that the Act states that EPA shall consult with both the U.S. Department of Health, Education, and Welfare and with the National Drinking Water Advisory Council in promulgating both the primary and secondary regulations. The interim primary regulations are even more interesting for what are not specified than for what are specified. However, I would like first to review the criteria that are specified, and in this review skip the material relating to turbidity and coliforms which concerns the microbiological integrity of drinking water supplies. Communicable diseases have long been a part of federal authority and are not the reason the Safe Drinking Water Act was passed. The Act was necessary in order to get control over chemical substances in drinking water, an authority the federal government never had, even though it was exercised.

In looking at the chemical substances and their health effects, it is necessary to remember that drinking water is only one of several routes by which a toxicant can be conveyed to the body. Limits for toxic materials must be based upon total intake which must include the air we breathe, the food we eat, and sometimes even direct skin contact. In prescribing the concentrations allowed in drinking water, it is asumed that an individual consumes 2 liters per day.

Arsenic

A dose of arsenic clears the human body in about 10 days and hence is accumulable over only a relatively short time. It has both kidney and liver consequences. It can occur in the pentavalent or trivalent forms - the latter being most toxic. Its occurrence is restricted mostly to groundwaters in areas subject to volcanism in ages past. However, it can also be found in industrially polluted waterways. The limit of 0.05 mg/l applies to total arsenic since the pentavalent form can reduce in the gut to the trivalent.

The 1962 U.S. Public Health Service (PHS) Drinking Water Standards contain a mandatory limit of 0.05 mg/l and a recommended limit of 0.01 mg/l for arsenic. The latter value was based on some unclear evidence that arsenic might be a carcinogen. In the last ten years, rather intensive study of arsenic has failed to document its carcinogenic properties in laboratory animals. Epidemiological studies of families using well water containing contrations of arsenic of 0.09 to 0.12 mg/l and even higher has failed to demonstrate any effects. A limit for arsenic of 0.1 mg/l was about to be proposed when an occupational cancer episode broke into the news, and hence the 0.05 mg/l mandatory limit was retained. Arsenic is a sulf-hydryl active metal and consequently exhibits additivity with other sulf-hydryl active materials. We'll return to this subject later.

Barium

Barium is a recognized muscle stimulant particularly effecting the heart muscle. It can also cause nerve block and produces a transient increase in blood pressure by vaso-constriction. Its occurrence is again mostly confined to groundwaters. Since no studies had been made of the amounts tolerable in drinking water, the standard for barium provides the classic example of how a drinking water standard can be fashioned from an air standard and which is based upon total intake concepts.

Cadmium

Cadmium is well-recognized as a highly toxic material. Many acute toxicity episodes are on record based upon contamination of food and beverages. One of the most severe occurred in Japan, resulting in a severely crippling and painful Itai-Itai (ouch-ouch) disease. Its presence in water may be from industrial waste discharges and/or from galvanized piping in which cadmium is a contaminant. Its most serious aspects concern chronic damage to the kidney and interference with uncoupled oxidative phosphorylation, an important pathway of metabolism. The late Dr. Henry Schroeder's studies on rats indicated that even the low standard of 0.01 mg/l may be too high over a lifetime of human consumption. It is also recognized that some compounds of cadmium are occupationally carcinogenic.

Chromium

The 1942 PHS Drinking Water Standards had set a limit for hexavalent chromium of "shall not be allowed" -- in other words, none. One of the members of the committee on revision of the standards operated a water system in which some of the wells had 0.02 or 0.03 mg/l concentrations of hexavalent chromium. To get his wells back in service, he prevailed upon the rest of the committee to raise the standard in the 1946 revision to 0.05 mg/l -- just high enough for his wells to qualify. This is the "scientific" way by which we acquired our drinking water standard for chromium. It stayed the same in the 1962 revisions but in the current primary regulations the 0.05 mg/l limit now applies to total chromium, not just to hexavalent chromium. Although some toxicologists believe trivalent chromium to be an essential form of the element, this is apparently not universally accepted. The chronic concern aspect appears to relate mostly to the known carcinogenicity of some chromium compounds when inhaled.

Lead

Most everyone has heard of the hypothesis that Rome's decline and fall can be attributed to lead poisoning of Rome's elite citizenry. One of the interesting anecdotes comes from Herschel Clemens who reports that the Marcian aqueduct provided the coolest, softest waters to Rome and that these waters were much in demand. Since lead piping was used at the time, and we now know what soft waters can do to lead pipe, we can guess as to how some lead got to Rome's leaders. Lead is a cumulative poison of the bone and is increasing in our modern environment. The increases relate mostly to leaded fuels and this is the main route EPA has chosen to control the problem. Lead and a number of other metals -- arsenic for one -- have an ability to react additively with the sulf-hydryl active group. Hence, protective enzymes that utilize the sulf-hydryl group will be impaired in their function. One of the cancer hypotheses concern environmental chemicals reacting with protective enzyme systems, thus lowering human resistance to carcinogenic agents. Certainly, lead, arsenic, and all related sulf-hydryl active agents are deserving of concern in this respect. The Soviet Union has limits for lead and arsenic of 0.1 and 0.05 mg/l respectively. A Russian scientist observed that when present together, one or the other limit should be halved in order not to interfere with the sulf-hydryl system used in her tests. This would defend the U.S. limits of 0.05 mg/l for each.

Mercury

Metallic mercury -- not airborne mercury vapor -- is rather inocuous. In the environment, however, it biologically converts to methylmercury. This can happen under aerobic or anaerobic conditions. Methylmercury is highly toxic, attacks cells of the nervous system, and has been responsible for the tragic Minamata disease episode in Japan. The Russians have long had a limit of 0 005 mg/l for mercury in drinking water, and when the mercury episode arose in the U.S., Public Health Service scientists derived the same limiting concentration. The new primary regulations specify a limit of 0.002 mg/l which is totally defensible. Mercury occurs mostly in groundwaters in areas containing mercury ores (cinnabar) and in waters contaminated by industrial wastes.

Selenium

Information on the toxicity of selenium is extraordinarily complex and controversial. Example 1 - there is evidence that it is an essential element, but this is not completely accepted. Example 2 - arsenic in drinking water accentuates the toxicity of selenium in drinking water, but when the selenium is in food, arsenic protects against selenium toxicity. Example 3 - selenium present in seliniferous grains is more toxic than inorganic selenium added to the diet. Example 4 - selenium administered to rats in drinking water increases dental caries. Studies in humans both support and refute these observations. Example 5 - Selenate administered to rats, from weaning till death, in drinking water was not toxic in terms of growth, survival, or longevity, but administered to older animals was both tumorigenic and carcinogenic!

Since selenium is cumulative in the kidney and liver and is of concern as a carcinogen, its limit of 0.01 mg/1 in the 1962 PHS Standards has been retained in the new EPA primary regulations.

Silver

The effects of silver are chiefly cosmetic, relating to argyrosis. In high concentrations it can damage the kidneys, liver, and spleen. A standard was considered desirable a number of years ago when it was observed to be an effective disinfecting agent. Its cost is now so high that there are few places in the U.S. -- if any -- that use it for disinfecting water. Further, not much silver is allowed to escape from industries that utilize it -- again because of its cost. Nevertheless, the level of 0.05 mg/1 has been retained.

Fluoride

The fluoride story has been widely publicized for many years. Its natural presence in drinking water was found to be related to a low caries incidence, and when present at too high a concentration caused mottled teeth. Consequently, it was added to water supplies in a controlled amount to protect against caries and was found to be highly effective. Since then it has been observed to be beneficial to the elderly by helping maintain stronger bones. The addition of fluoride or any other similar agent to drinking water is addressed in Section 1412 (b) (6) of the Safe Drinking Water Act. "No national primary drinking water regulation may require the addition of any substance for preventive health care purposes unrelated to contamination of drinking water." Hence, the primary regulations for fluoride are to protect against fluorides being present at too-high concentrations. In other words, Congress recognizes the social nature of some decisions -- which we should all recognize will become an increasing part of our daily lives as time passes. Witness the atomic energy program's problems, and the concern about wastewater reuse.

Nitrates

The nitrate limitation is to protect infants against methemoglobinemia. Its very presence in the 1962 PHS Standards and in the new primary regulations raises an exceedingly interesting point. Infants comprise a highly visible, identifiable part of the population. It is easy to specifically identify them as individuals who should use another water supply if an existing supply contains more than a 10 mg/l concentration of nitrates. Yet, we are going to make all drinking water supplies meet this limitation in order to protect this highly visible part of the population. But in the case of sodium, which is not limited in the interim primary standards, we have a material that is of concern to an estimated 21 to 27 million Americans most of whom do not realize they should be concerned. Further, there is no certain way by which every individual can determine their own vulnerability beforehand. It seems to me that something is seriously out of order in-so-far as our approach to nitrates and sodium is concerned.

Pesticides

The primary regulations establish limits for chlorinated hydrocarbon insecticides and for chlorophenoxy herbicides. The chlorinated hydrocarbons as a class of chemicals are man-made and exhibit, in general, long-term residence in the biosphere. The concern for their effects on mammals relates to the nervous system, primarily the brain, and to tumorigenesis.

The limitation for methoxychlor is based on both human and animal studies and incorporates a 10-fold safety factor. Since there are no human data for endrin, lindane, and toxaphene, a 500-fold safety factor has been used in setting limits. There also exists no human data for the herbicides' toxicity and a similar 500-fold safety factor has been incorporated in setting limits for these substances.

Organics

A general limitation for toxic organic materials -- other than for the pesticides -- is missing from the interim primary regulations. The finding of carcinogenic organics in the drinking water of New Orleans supplied the main reason for passage of the Safe Drinking Water Act. EPA is busy conducting studies to find out what organics are present in today's drinking water supplies and at what concentrations. Some of these studies relate to chloroform and other halomethanes which are formed as a byproduct of chlorination when precusor organics are present. Control possibilites include carbon adsorption treatment to remove the precursor organics, or using ozone in lieu of chlorine as the disinfecting agent. Congress recognized that it is not possible to specify no-effect levels for all toxicants. In these situations, the Act states that EPA shall specify the treatment techniques that are to be used. This opens the door to a social decision since cost must be taken into account. Science and technology cannot always supply decisions, but they can supply information upon which more rational decisions can be made.

Secondary Regulations

The first materials I've received relating to the proposed secondary regulations indicate that EPA is considering limits for chloride, color, copper, methylene-blue active substances (MBAS), iron, odor, manganese, and sulfate that are essentially identical to those recommended by the 1962 PHS standards. These limits are:

Chloride, mg/l	250
Color, units	15
Copper, mg/l	1
MBAS, mg/l	0.5
Iron, mg/l	0.3
Odor, number	3
Manganese, mg/l	0.05
Sulfate, mg/l	250

The limits are suggested to prevent esthetic problems due to taste, odor, color, foaming, or staining. For copper, manganese, and sulfate, however, there exist health aspects. Since "esthetic" problems from these substances occur at lower concentrations than health problems, the substances are not limited in the primary regulations. Yet Congress stated that, "Both primary and secondary drinking water regulations may be established for the same contaminant, if the statutory criteria are met."

The limit for sulfate "was chosen to afford a reasonable factor of safety against having drinking water cause a laxative effect." EPA considers a chemically induced diarrhea to be an esthetic problem, not a health problem!

Sodium is discussed in the proposed secondary regulations, and the discussion is excellent. Everyone should read it. Individuals on a 500 mg/day sodium diet should not drink water with a sodium concentration more than 20 mg/l. Individuals on a moderately restricted sodium diet should not drink water of more than 270 mg/l sodium content. However, a specific limiting concentration for sodium -- a sodium "Standard" -- is not proscribed. The discussion recommends that the sodium content of drinking water supplies be provided to local physicians, and also states that "Special efforts of public notification must be made for supplies that have a very high sodium content..."

My personal feeling is that the discussion on sodium belongs in the primary -- not the secondary -- regulations along with that of sulfates. It is not necessary that EPA set a maximum contaminant level for either of these substances because of the high cost associated with removing them. (The Safe Drinking Water Act allows for this.) But concentrations of sodium and of sulfate in excess of 20 and 250 mg/l respectively should be continually reported to the public -- not just the local physician. As far as copper and manganese are concerned, limits for these substances also belong in the primary regulations even if the health limit proves higher than the limit based upon esthetics.

I would like to conclude with two thoughts that pertain to the National Drinking Water Advisory Council. First, the members of the council are quite aware that specifying substances and limits for substances in drinking water is not entirely the preventive mechanism we would all like for it to be. Coliform results, for example, are obtained days after the waters are drunk. The most effective means of protecting the integrity of our water supplies is through the sanitary survey and the many preventive aspects associated with it: trained operators, sound equipment, adequate pressures, protected sources, and appropriate treatments. Hence, the council has been emphasizing from the beginning the importance of the sanitary survey. I am reminded of the words of a PHS medical officer in 1919: "Water supplies heretofore have been passed upon by bacteriological standards. Very little attention has been paid to (sanitary) survey standards which engineers would likely set. I think the time has come to adopt the engineering point of view. The bacteriologist will only be a checker-up and I think I can convince you ... that we should adopt the (sanitary) survey method of accepting a water supply rather than the bacteriological." The sanitary survey is today still the most important preventive function concerning our water supplies. Limits for bacteria, chemicals, etc. constitute only the "check-up" part of the program.

Lastly, I wish to commend the National Drinking Water Advisory Council for the diligence it is displaying in carrying out the advisory function and Mr. Russell Train for his effective leadership and willingness to respond to the council's advice. Were it not for Mr. Train, the council would be just another ineffective appendage of the bureaucratic process.

IMPACT OF SAFE DRINKING WATER ACT ON NEW MEXICO

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When Prof. Clark asked me to be a speaker at this 21st Water Conference, I suspect he didn't realize how pleased I was and that I was also amused. One concern of the Advisory Committee has been that we seem to be talking only to ourselves at these conferences. I would like to suggest, particularly to the newcomers to the Conference, that this statement may be true, but shouldn't be of concern.

My interest in New Mexico's water problems is a direct result of the Water Resources Research Institute (WRRI). Almost exactly five years ago today, WRRI's Dr. Stucky began a series of Citizen's Water Conferences throughout New Mexico. The purpose of these meetings was to determine some of the most pressing water problems of our communities. I attended the meetings in the north central area and began attending the Water Conference each spring. Today, I am a speaker, so you might say we are "talking to ourselves".

Instead, I believe the Water Conference has a confortable blend of participants who are very knowledgeable in the history of water use and the problems associated with its development in New Mexico and those who are more like myself, i.e. relative newcomers interested in solving the problem associated with the continuing use of a vital resource, as our population continues to increase.

WRRI's annual conference, I believe, provides an effective means by which new ideas to cope with the changing aspects of water use and development can be explored. Private citizens and public servants alike can learn what water problems are receiving the most attention and how this emphasis affects their particular concerns.

The topic selected for today's conference is an example of where the emphasis is being placed today. Let us look at how the federal Safe Drinking Water Act will affect us in New Mexico.

The Act directs the EPA to develop a series of regulations to be implemented at the state and local levels, and it was the intent of the act that the states enforce them. The programs under way are listed in the slide and include:

1. Interim primary drinking water regulations for public water systems that specify:
    a. Maximum contaminant levels for chemical and microbiological constituents.
    b. Monitoring frequencies
    c. Analytical methods
    d. Repeat sampling procedures
    e. Public notification
    f. Reporting requirements
    g. Record keeping requirements
2. Regulations defining state responsibilities and grant requirements for supervising the water supply program.
3. Regulations for state underground injection control (UIC) programs.
4. Regulations defining state responsibilities and grant requirements for supervising the UIC program.
5. National Rural Water Survey to determine the quantity, quality, and availability of rural drinking water supplied by nonpublic systems.

It is interesting to note that during the last four years, the passage of federal water legislation has closely paralleled the identification of the state's water problems. The Citizens' Conferences ranked the ten most pressing water problems in 1971. The slide shows the five most important water problems identified.

1. Declining ground water table and diminishing surface water supply.
2. Need for improved irrigation systems and water use management in irrigated agriculture.
3. Water pollution.
4. Need for knowledge of present and future supplies and demand of water.
5. Shortage of water for industrial, recreational, and municipal uses.

Except for Problem #2 concerning irrigated agriculture, the federal Water Pollution Control Act Amendments of 1972 (PL 92-500) and the Safe Drinking Water Act of 1974 (PL 93-523) provide methods for dealing with the other four problems. Even though the need for the federal legislation appears to be justified by citizen demands, the implementation of this legislation at the state and local levels can be so inappropriate that the legislation fails in its intent.

This would have been the case if the primary drinking water regulations had been adopted as they were first proposed more than a year ago. The proposed regulations placed an unjustified emphasis on the monitoring of ground water supplies where water quality varies little from year to year. In addition, the regulations required extensive sampling that placed a burden on small communities where economic resources are severely limited. The proposed regulations were an excellent example of how federal legislation cannot be implemented at the state and local levels without consideration of state and local problems. Fortunately, EPA realized that the proposed regulations did not inspire many states to seek the primary responsibility of administering the Safe Drinking Water Act and made a genuine effort to resovle the issues. Perhaps they were pushed in this direction by the fact that if EPA didn't get the states to implement the act then EPA would have to take the responsibility of administering the act.

In working to develop a program that could be administered by the states, the EPA enlisted the help of 27 state and local officials and private citizens. New Mexico was continuously involved during this period. As you know, John Hernandez and Dr. Wolf were appointed to the 15-member National Drinking Water Advisory Council and Francisco Garcia, of the Environmental Improvement Agency, represented the state at many meetings of the EPA work groups. The willingness of EPA to listen to state-local problems has resulted in the interim regulations being more adaptable to local situations. Where the cost of compliance however still proves to be a burden, a community can obtain a varience or exemption or request funds from the state under the Water Supply Construction program or Sanitary Projects Act.

In the past, federal regulations have been drafted based on the idea that national legislation can be uniformly administered only if a goal is decided upon and a method is selected to reach that goal. At first EPA did not acknowledge that different methods can be used to achieve a common goal or that problems in one area may not be urgent in other areas. Regulations used to implement federal law were often not responsive to local needs.

Since then EPA has realized that regulations must be "flexible". This is the new word heard around EPA today when regulation drafting is being discussed. We can see how flexibility, or being realistic, as I prefer to call it, has been used in drafting the interim primary drinking water regulations.

The proposed regulations were based on three assumptions shown in the slide:

1. Small communities of fewer than 2,500 persons are not characteristic.

2. Surface water is the major source of drinking water.

3. Treatment is the method that should be used to obtain safe drinking water.

While these assumptions are applicable to many of the nation's urban areas, not one of them is characteristic of public water systems in New Mexico.

Let us compare these assumptions to our situation here. The state has approximately 370 public water supplies that serve about 80% of the state's population. Fewer than 10% of these serve communities larger than 2,500 persons. The proposed regulations grouped all communities from 25 - 2,500 population in one category that required two coliform density samples per month and did not differentiate between surface and ground water supplies. Yet as we see 94% of our drinking water comes from ground water supplies. The interim regulations, which were promulgated in December, 1975, have broken this category into two. Now communities with a population of 25 - 1,000 are required to collect only one bacteriological sample per month and this can be reduced further by the state on the basis of sanitary surveys if the system has a ground water supply. Sampling for pesticides in ground water supplies was originally required, but the interim regulations leave it up to the state to decide if pesticides are a problem and require sampling. The interim regulations also allow for analytical work to be done by the state. This is a significant change from the proposed regulations which required the individual system to purchase this service. Our state laboratory has historically done water chemistry analyses for our water systems. If the individual system would have had to bear the cost of analyzing the required samples, the impact of the regulations would have been substantial. The interim regulations do not alter this procedure. Samples can be sent to the state laboratory for analysis and federal funds can be used to help pay the cost. We estimate that this cost will be approximately $250,000 during the first two years of the program. Presently the state spends $180,000 for water chemical analysis.

Now let us apply assumption #3 to New Mexico. Since surface water supplies are susceptible to rapid changes in their chemical composition, treatment of the water supply becomes necessary and frequent monitoring is important if safe drinking water is the goal. EPA's emphasis on treatment of surface supplies is justified on the national level. However, the situation can be quite different where ground water is the source of drinking water. The chemical quality is relatively constant and contamination appears slowly providing time to cope with a pollution problem before drinking water standards are exceeded. Frequent monitoring is not necessary. The practical approach is to establish a water supply that meets the standards either by regionalization of the water system or dilution. This is an important factor in providing water for domestic use in New Mexico. Where a ground water supply exceeds one or more of the drinking water standards, it is often cheaper to find an alternate supply or dilute the existing supply down to the standards rather than treat the supply. The cost of treatment becomes acceptable only when it can be divided among a large number of users. As we have seen, size is not characteristic of water systems in New Mexico. Annual per capita treatment costs become acceptable only as the system nears 10,000 persons or more. When a system reaches this size, costs range from $1 - $35 per person per year, depending on the type of treatment required; but for systems serving less than 100 persons, the cost of treatment can range from $2 - $237 per person per year.

Since New Mexico's communities are small and rely on ground water for their water supply, we find New Mexico using a different approach than the EPA envisioned as a national norm for providing citizens with acceptable domestic water supplies.

Under the authority of the Water Quality Act, the Water Quality Control Commission is considering the adoption of ground water standards to protect ground water domestic and agricultural use rather than allow the water supply to become contaminated and require each subsequent user to treat the water.

PL 93-523 also requires EPA to protect underground sources of drinking water. Part C of the Act requires the Administrator of EPA to promulgate regulations for state underground injection control (UIC) programs by December, 1975. The UIC regulations have not yet been proposed; however, a review of the latest draft indicates they will have little impact on New Mexico if promulgated in their present form, except perhaps for the oil and gas regulations.

The draft UIC regulations bring under federal control only injection wells associated with the production of oil and gas and waste disposal wells, barrier and recharge wells, mining and geothermal wells. These types of wells have not presented a ground water contamination problem in New Mexico in the past, although the possibility is increasing that they will in the future. The mining industry is developing in situ mining techniques in the state and subsurface waste disposal is increasing. The federal Water Pollution Control Act Amendments of 1972 (PL 92-500) has encouraged the subsurface disposal of waste since it is a method of eliminating the need for an NPDES permit. Indeed, it was this weakness in PL 92-500 that contributed to the passage of the Safe Drinking Water Act with Part C devoted to protection of present and potential drinking water supplies.

The draft UIC regulations do not address sources of ground water contamination that have been of concern in New Mexico. The draft UIC regulations do not control at this time such pollution sources as surface impoundments, tailings ponds, lagoons, the uncontrolled land application of municipal sewage and the discharge of wastewater to dry arroyos and ephemeral streams where recharge of the ground water can occur. The regulation of these sources is being left to the states.

The Water Quality Control Commission has recognized the need to protect ground water quality and is proposing to control these sources of ground water contaminants. Proposed ground water requlations have been approved for public hearing this summer. Consequently, the major impact in the area of ground water protection will come from the adoption of these state regulations.

In conclusion, it appears that the major impact of PL 93-523 will result from the analytical requirements, that Mrs. Brandvold will discuss, and the record keeping and reporting requirements that must be met by the hundreds of operators of public water supply systems. When the requirements become effective in June of 1977, it is anticipated that only 25 - 30 systems will not meet the standards and the regulations provide two to three years after this date for these systems to achieve compliance or operate under a varience. However, operators must keep records of analyses and notify the public and the state of violations, recedures which are new and will take time to learn. The Act will cause a greater awareness of the quality of our water supplies and contribute to the debate - what constitutes reasonable degradation of water quality in a water-short state.

PROBLEMS IN THE LABORATORY

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Implementation of the regulations we have been discussing today will depend upon reliable chemical analyses. In fact, the whole Safe Drinking Water Act hinges on the ability of analytical personnel to consistently day after day obtain reliable results. Without good analytical data, the regulations cannot be enforced and without enforcement the regulations are worthless. Reliable data is also critical in terms of keeping costs down, since systems in violation must repeat analyses and public notification is required of systems in violation. Reliable data is also necessary for technical operations and long range planning. And, of course, reliable data is necessary to protect the public health and peace of mind. (Data which is in error by being too low can endanger the public health, and data which is in error by being too high can unnecessarily alarm the public).

What then is involved in obtaining consistent reliable results? The first concern is sampling. The chemical analyses will be only as good as the sampling. The sample must be taken in such a manner that no contaminants are added and the constituents which are sought are not lost. Complete preservation of samples is a practical impossibility. At best, changes can only be retarded. Changes can occur because ions may precipitate, change valence state, dissolve, volatilize, form complexes, be adsorbed onto the container surface or exchange ions with the container surface. Changes can also occur because of biological action. Soluble constituents may be converted to organically bound material, or cell lysis may result in release of cellular materials into solution. There is no one method of preservation which will retard all types of changes. Decisions must be made in advance of sampling as to the desired constituents and the method of preservation. Sometimes several samples are taken and several methods of preservation employed. A satisfactory sample must also be a representative sample. It must reflect the total water. A decision needs to be made as to whether to use glass or plastic containers, add acid or whether the sample is going to be heated or cooled. It is impossible to give directions covering all conditions so sampling must be at least supervised by qualified personnel. In general, the shorter the time between sample collection and analysis, the more reliable the results. Qualified personnel are going to be needed and this is not college students, colleges are more interested in teaching theory. We are going to need on the job training to be qualified and this will be a problem in New Mexico.

In the chemical laboratory, the water and chemicals must be of high quality and free of trace contaminants. Ordinary tap water obviously isn't good enough and must be distilled. The best type of still is all glass, which is three or four times more expensive than a metal still. Many laboratories use metal stills because they are cheaper but water distilled in a metal still contains metal ions, which must be removed by ion exchange columns. Distilled-deionized water will still contain dissolved carbon dioxide which may have to be removed by boiling. The chemicals used in the various assays must be of the best quality. This has always been important but now when analyses extend into the ppb range, it is an absolute must. Many times this necessitates further purifying the chemicals in the laboratory or buying specially purified chemicals and there is a difference between companies as far as chemical purity is concerned. Either way it adds to the cost.

All glassware must be scrupulously clean. Having the glassware clean enough to eat off of isn't good enough. It must have no trace contaminants absorbed to the sides of the glass. This is important again because of the very trace amount being sought. For biological assays the glassware must be sterilized and if taken into the field must be kept sterile. Another problem with dirty glassware is that it not only causes contamination but also inaccurate measurement. A dirty pipet won't deliver the volume of liquid it should. When you are working with very small amount, being off a drop or two is very important.

The best method of analyses in each particular case must be decided upon. The decision must be based on the degree of accuracy required, the expected concentration of the desired constituent, the interferences which may be encountered, the amount of time required for analysis, the established validity of a method and the skills and equipment required.

The analyst must also keep in mind the fact that an element in the presence of others may behave quite differently than when it is by itself. There is no problem finding methods of sufficient sensitivity for the determination of elements when they occur alone. The rub comes in because elements never occur alone in water and further more in the case of analyses required by the Safe Drinking Water Act one is expected to determine small amounts of an element in the presence of very large amounts of other elements.

Before analysis, all forms of the element must be converted to the same form. This is extremely important and is the point where the technicians are separated from the analysts. This is one of the problems with the selenium analysis. In the case of mercury analysis all forms of organic mercury must be carefully converted to inorganic mercury in the +2 valence state before analysis is attempted. This must be done without losing any mercury which is difficult since mercury is volatile.

Any expected interferences must be removed before analysis or corrections must be made for them. An alert analyst is constantly asking himself (herself?) "What interferences may be expected?" "How can they be corrected for?"

Adequate standards are a necessity. Two types of standards are needed. An external standard, to standardize the reagents and/or equipment. This usually consists of a standard curve, various amounts of the element in distilled water. The internal standard generally consists of a known amount of the element in the same matrix as the sample. This is the difficult standard to obtain since the major constituents in the water sample aren't likely to be known and would be expensive to determine and duplicate for each sample. A method of handling this problem is by spiking an aliquat of each sample with a known amount of the element in question. This is called the "Method of Additions". One precaution that should always be observed if possible is that the added known be in the same chemical form as the unknown. This isn't always possible and is another reason why care should be taken before the analysis to convert all forms of the element to the same form. The known amount should always be added at the beginning of an analysis. This aids the analyst in being sure that the known is in the same chemical form as the unknown and will also help the analyst account for any losses. An analysis where this is particularly important is the analysis of mercury. Even so the "Method of Additions" can't correct for every type of interference. In the case of atomic absorption analyses, for instance, it won't correct for "non-molecular" absorbance.

The analyst must now consider the accuracy of his result. There is a wide misunderstanding as to the accuracy of results obtained in analytical work, and also a confusion between precision and accuracy. A useful concept here is that of a target. Three shots that are clustered at one side of the target are precise, but not accurate. Conversely, shots clustered about the bullseye are accurate. Precision can be easily established, but it is extremely difficult to judge accuracy, since in chemical analysis the "real" answer is never known. How then is the most probable value established? This is only safely done by carefully determining the constituent by methods that differ from each other as much as possible. This obviously is extremely costly, and not necessary for routine monitoring, provided that the method being used has been shown to be reliable. However, in the case of a disputed analysis, it is the way to establish the most probable value. Another misunderstanding exists as to the term sensitivity. Sensitivity refers to the degree of response received for a certain amount of an element and in no way implies accuracy. Consider the emission spectrograph, for example, it is highly sensitive; copper in a solid can be determined to 1 ppm or less, but the results have an accuracy of $\pm$ 50%.

The National Interim Primary Drinking Water Standards list maximum contaminant levels for 22 parameters, including trace inorganics, trace organics and radioactivity. E. P. A. has certified to Congress that these maximum contaminant levels are analytically obtainable, which doesn't necessarily imply accuracy. What this means is that an analyst with sometimes very expensive equipment (under the best conditions) who is very familiar with that particular assay can reach those certified limits in a sample containing distilled water and the element of interest. This is different from "real world" conditions, where an analyst is responsible for running many different assays on the least expensive, most practicable equipment in solutions that vary from low T. D. S.

(total dissolved solids) to high T.D.S. In New Mexico not only does the T.D.S. vary but can range from high sodium chloride-low calcium sulfate to high calcium sulfate low-sodium chloride, to high calcium bicarbonate-low sodium sulfate and all variations in between. The colloidal content of New Mexico waters is also very high. The minor elements can range all over the place and the analyst is looking for trace elements at the ppb range.

As far as New Mexico is concerned there is going to be a problem with having adequate laboratories. Of the 22 parameters, 4 could be routinely determined by a trained technician using relatively inexpensive equipment, the others require either highly trained personnel or expensive equipment or both.

The Safe Drinking Water Act specifies that analyses conducted for the purpose of determining compliance must be done by a laboratory approved by the entity with primary enforcement responsibility (E.P.A.). The E.P.A. has already certified the HSSD state laboratory. However, this laboratory won't be able to handle the volume of analyses required and for the biological assays, many communities are to far away to be able to send assays to the state lab. As far as I have been able to ascertain, there is at present only one other laboratory in the state which has the capabilities of determining all the parameters and could be certified.

Cost is another problem. The average cost of analyzing water for drinking water requirements is going to cost about $200.00 a sample, and this doesn't include sample collection. Especially for the smaller communities this is going to be expensive.

Finally, what happens when there is a disagreement between discharger and certifying agency as to the exact level of a contaminant? I don't see any provision in the Act which covers this problem.

The regulations specify the procedures to be followed in analyzing samples for each of the maximum contaminant levels. This is fine but it doesn't necessarily assure reliable results. This is what I have been trying to emphasize this afternoon, that reliable results depend on a multitude of things. The analyst must be concerned about sampling, labeling of samples, storage of samples, the quality of the chemicals and distilled water, about glassware, about maintenance of equipment, the analytical method itself, any expected interferences, adequate standards, accurate mathematical computations and proper recording of the data. Carelessness at any point can negate the complete analysis.

There appears to be an assumption on the part of Congress, E.P.A. and even the general public, that the analyses of the maximum contaminant levels is going to be cut and dried, that the "real" amount of a contaminant will be readily determinable. This assumption is wrong, could cause confusion and alarm, endanger the public health by causing a false sense of security, and in any case will be costly.