10-23-1977

A-B Cattle Co. v. U. S.

IN THE SUPREME COURT

OF THE

STATE OF COLORADO

CASE NO. 27714

A-B CATTLE COMPANY, et al., Plaintiffs,	)	CERTIFICATE TO THE SUPREME COURT OF THE STATE OF COLORADO
vs.	)	
THE UNITED STATES OF AMERICA, Defendant.	)	

APPENDIX OF AMICI
SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT
COLORADO RIVER WATER CONSERVATION DISTRICT
SOUTHWESTERN COLORADO WATER CONSERVATION DISTRICT
LOWER SOUTH PLATTE WATER CONSERVANCY DISTRICT

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APPENDIX TO AMICI BRIEF

SUSPENDED SEDIMENT AND THE PUBLIC INTEREST

Suspended sediment is carried by flowing river water. It settles out, for the most part, when water is impounded and slowed. This is in accordance with the laws of gravity, basic physics, and hydraulic phenomena.

Suspended sediment is a pollutant under national and state water quality legislation and regulations.

Suspended solids, which includes both organic and inorganic suspended sediment, and biochemical oxygen demand are the two pollutant constituents which receive the most attention and regulation from the water quality regulatory agencies. Water Quality Control Commission, Regulations for Effluent Limitations, Colorado Department of Health (April, 1975). (See them in the Appendix.) The proposed 1983 Colorado Water Quality Standards, Water Quality Control Commission, Proposed Water Quality Standards for Colorado, Colorado Department of Health (April, 1977), under consideration by the Water Quality Control Commission (WQCC), list 25 milligrams per liter (mg/l) as a maximum concentration of man-added suspended solids in colorado streams to be classified for cold or warm water biota, with a footnote reading as follows:

> "25 mg/l for stream segment attributable to municipal, industrial, agricultural, construction (including highways), and reservoir draining."

The State of California has published Harold W. Wolf's book, Water Quality Criteria, California State Water Resources Control Board (1962). Under "Suspended Solids" on Page 279, the book states that:

> "The impact of man's activities, however, alters and augments the suspended solids in surface waters by the discharge of liquid wastes from communities and industries, by increased erosion from deforested and cultivated areas, by gravel workings and mine tailings, by steel mill wastes, and by dusts that are blown into streams."

Page 280 of Water Quality Criteria states the deleterious effect of suspended sediment:

> "c. Fish and Other Aquatic Life. Disregarding any possible toxic effects attributable to substances leached out by water, suspended solids may kill fish and shellfish by causing abrasive injuries; by clogging the gills and respiratory passages of various aquatic fauna; and by blanketing the stream bottom, killing eggs, young, and food organisms, and destroying spawning beds. Indirectly, suspended solids are inimical to aquatic life because they screen out light and because, by carrying down and trapping bacteria and decomposing organic wastes on the bottom, they promote and maintain the development of noxious conditions and oxygen depletion, killing fish, shellfish and fish food organisms, and reducing the recreational value of the water."

(Here, as in all the rest of this Appendix, except for headings or where specifically noted, emphasis in quotes has been added by amici.)

The American Society of Civil Engineers (ASCE) published Sedimentation Engineering in 1975.[1] On Page 8 appears the following quote:

> "Quality of Water. Sediment is not only the major water pollutant by weight and volume (United States Committee on National Water Resources, 1960), but it also serves as a catalyst, carrier, and storage agent of other forms of pollution. Desirable qualities of water vary according to use and there are a few uses in which sediment in the water is desirable. Usually, however, the greater the sediment concentration, the poorer the quality. Sediment alone degrades water specifically for municipal supply, recreation, industrial consumption and cooling, hydro-electric facilities, and aquatic life. In addition, chemicals and wastes are assimilated onto and into sediment particles. Ion exchange occurs between solutes and sediments. Thus, sediment has become a source of increased concern as a carrier and storage agent of pesticide residue, absorbed phosphorus, nitrogen and other organic compounds, and pathogenic bacteria and viruses. Additional information is needed on the chemical and biological relationships of sediment. Studies are underway to determine more precisely the behavior of pesticides and other chemicals in soil, water, and other segments of the environment."

[1] Vanoni, Vito A. (Editor). Sedimentation Engineering. ASCE Task Committee for the preparation of the Manual on Sedimentation. New York, N.Y. (1975).

Many billions of dollars are being spent by the U. S. Environmental Protection Agency and the Colorado Water Quality Control Commission. Suspended sediment is a pollutant which harms the public health, safety, and welfare. Regulations generally recognize a "natural" suspended sediment concentration which is part of an established regime to which the environment has adjusted. Yet, no one knows what the natural sediment concentration of a particular stream would be without man's influence.

RIVER DYNAMICS AND SEDIMENT VARIABILITY

A river constantly changes. It may be almost dry one day and flooding the next. In a drought year the annual flow may be a small percent of the next year's. The course of a river may change from one side of a valley to the other during a flood. One day a river may support an active fishery, and by a flood like the 1976 Big Thompson Canyon flood, the fishery may be destroyed for years. Todd, Darryl, Big Thompson Fishery Rehabilitation, Colorado Division of Wildlife (December, 1976).

In addition to natural changes, man constructs dams, reservoirs, ditches, tunnels, water and sewage treatment plants, to make the river more predictable and manageable and to serve the public interest, health, safety, and welfare.

Man has always had to adjust to the vagaries of a changing river whenever he settled on its banks. For 5,000 years Egyptian culture revolved around annual silt-laden floods originating on the Blue Nile in Ethiopia. Egyptians are now adjusting to the new Nile flow following construction of the Aswan Dam which controls the floods and collects silt in its reservoir.

The suspended sediment carried by a river varies from day to day as well as year to year. For a particular river basin and level of development, suspended sediment relates most directly to stream discharge; that is, the higher the stream flow, the higher the suspended sediment concentration (expressed in milligrams per liter or parts per million), and total sediment load (in tons per day).

A detailed study of sediment on the Arkansas was done before the issuance of House Document 187, the plans adopted in the Fryingpan-Arkansas legislation. It is Appendix I "Sedimentation" to House Document 187, cited there at 44, part of Project Planning Report No. 7-8a.49-1 January 1950, on file in the Regional Office, Bureau of Reclamation, Denver, Colorado.

Regular sediment measurements by the U. S. Geological Survey began in October, 1964, for the Arkansas River near Portland. U. S. Geological Survey, Water Resources Data for Colorado, Part 2 Water Quality Records ([Annual] 1964-1974). Measurements of suspended sediment concentration for the Arkansas River near Portland, Colorado, from 1964 to 1974, is presented in Figure 1.

Note the high sediment concentrations which generally coincide with the spring runoff, while during the low flow periods, the sediment, concentration, and load is also low.

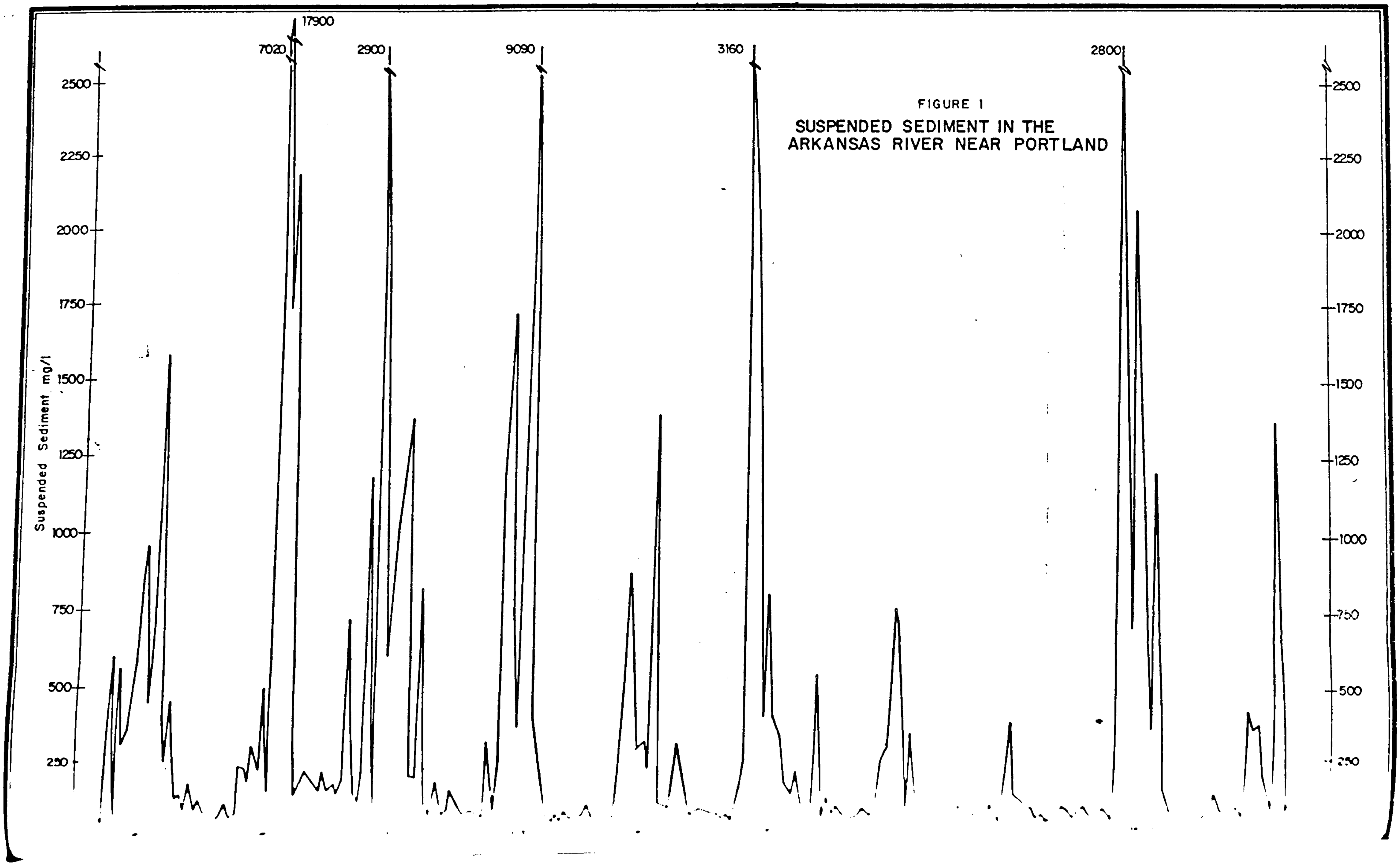


FIGURE 1
SUSPENDED SEDIMENT IN THE ARKANSAS RIVER NEAR PORTLAND

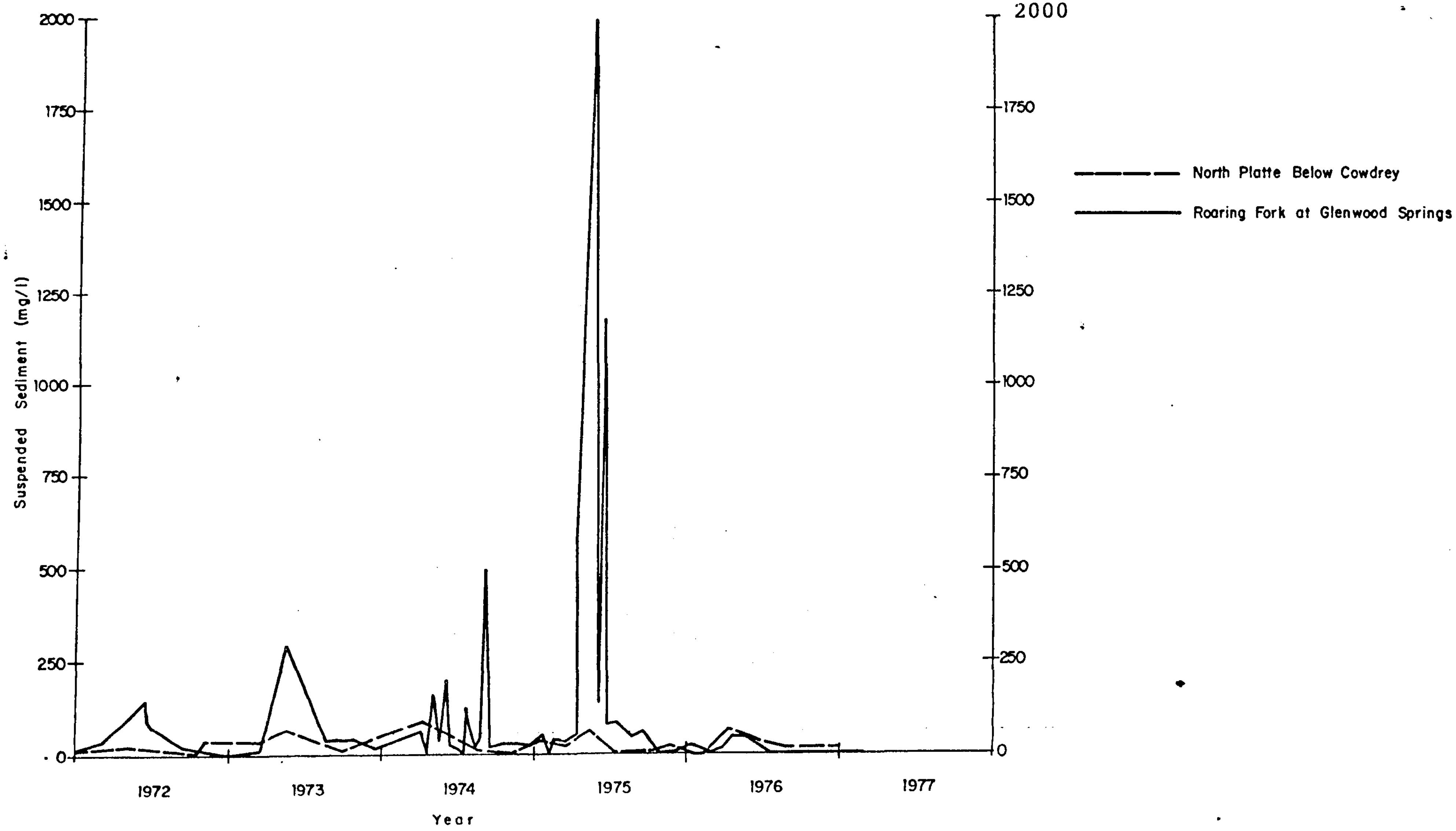
The sediment concentration and the total sediment load in any river are highly variable and subject to both natural and man-made phenomena. The natural factors include the magnitude of rainfall, the amount of snowmelt, and the erodibility of the solids in the drainage basin. The man-induced factors are the level and type of agricultural, industrial, urban, and transportation development and water use.

Sediments in a river basin are related to the degree and quality of land husbandry. For example, the North Platte River and the Roaring Fork River have good agricultural and forestry practices, and a minimum of major highways and railroad rights-of-way. While mining activity has been high in Pitkin County, it is concentrated around the City of Aspen.

Figure 2 presents a five-year record of suspended sediment concentration expressed in milligrams per liter of the North Platte and Roaring Fork. Colorado State Health Department, Storette Water Quality Data, Roaring Fork at Glenwood Springs and North Platte Below Cowdry, 1972-1977. Note the contrast between these rivers, which are close to the 25 mg/l standard for 1983 man-added suspended solids, and the Arkansas river shown in Figure 1. The North Platte River sediment concentrations are consistently very low; the Roaring Fork, usually low, but occasionally high.

FIGURE 2

SUSPENDED SEDIMENT IN STREAMS WITHIN PROPERLY MANAGED DRAINAGE BASINS



Thus, ditch or reservoir designs for the Colorado (see Figure 3 below), South Platte, or Arkansas Rivers might anticipate heavy sediment loads, but not for the North Platte, Roaring Fork, or other rivers draining a pristine or well-managed basin. Increased mining, sprawling subdivisions, or heavy highway and railroad construction, increase sediments.

A case study written for Harvard Business School use in 1976 by Mr. Lee White and Professor A. Marc O'Brien dealt with water quality and sediment pollution as it affected the Burlington Northern Railroad Timber Department.[2]

White and O'Brien wrote:

> "Montana--a state with little industry and much agriculture, forestry, and mining--has declared pollution from non-point sources, sediment in particular, as its number one water pollution problem * * *.
>
> "In the states with large commercial timber operations, forestry has long been identified as a potential source of non-point pollution. * * * Logging road construction, timber harvest and site preparation for reforestation 'have the greatest potential for temporarily increasing the contribution of pollutants (chiefly sediment) to surface waters.' * * * as sediment levels build, stream temperatures are also known to rise."

How much of the sediment load of the Arkansas River in Colorado is due to former poor forestry practices is unknown, but it is believed to be a substantial part.

A RESERVOIR IS A SEDIMENT TRAP

The suspended-sediment capacity of a river is directly related to its velocity and slope. All lakes and reservoirs decrease the flow, slope, and sediment-carrying capacity of the river. The suspended sediment, whether silt, sand, gravel, or plant debris, settles to the bottom, and slowly fills the lake. This filling ages the lake from a deep lake to a shallow lake, marsh, and finally meadow. The rate of aging is partially dependent

[2] White, Lee and A. Marc O'Brien. Burlington Northern, Inc. Timber Land Department: Water Quality Regulations. Harvard Business School (1976).

upon the sediment inflow, but happens, eventually to all lakes. The filling of older reservoirs was one reason for building Pueblo Reservoir as a new sediment trap.

Figure 3 presents a twenty year record of the average monthly suspended sediment concentration in the Colorado River at Lee's Ferry, Arizona, showing the situation before and after storage began behind the Glen Canyon Dam.[3]

The dam is 16 miles upstream from Lee's Ferry. Note the fluctuation and high levels of suspended sediment before storage began in March, 1963, and the consistently high quality water afterwards. Note also the different scales in Figures 2 and 3. In Figure 1 for the Arkansas most years have some period in which sediments exceed 1000 mg/l. In Figure 2 for the North Platte and Roaring Fork, most years do <u>not</u> exceed 100 mg/l. In Figure 3 for the Colorado, until 1963 half of the years exceeded 10,000. Where could this Court draw the line for cases where complaints about sediment would vary between 100 mg/l and 10,000 mg/l. Reservoirs are always sediment traps, cleaning up the lower stream.

[3] U.S. Geological Survey. Water Resources Data for Arizona, Part 2, Water Quality Records (Annual) 1964-1974; U.S. Geological Survey. Quality of Surface Waters of the United States, Parts 9-14 (Annual) 1953-1963. Water Supply Papers.

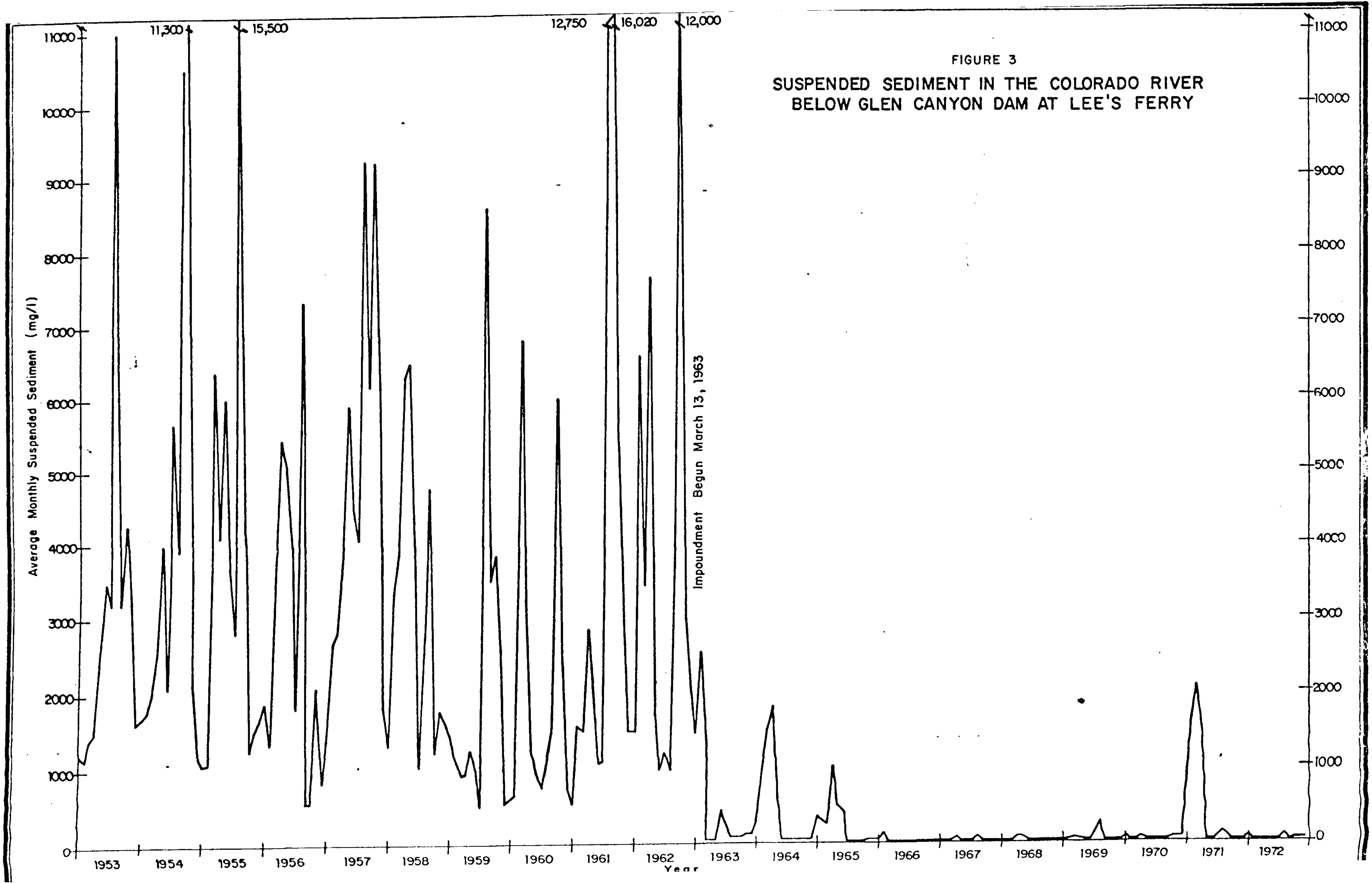


FIGURE 3

SUSPENDED SEDIMENT IN THE COLORADO RIVER BELOW GLEN CANYON DAM AT LEE'S FERRY

In Water and Metropolitan Man, the American Society of Civil Engineers, shows that one of the purposes of storing water for city use is to reduce sediments in order to improve water quality.[4]

"Uses and Objectives of Detention Storage:

"1. Reduction of flood damage
"2. Downstream hydrograph control
"3. Water-oriented recreation
"4. Water Supply
"5. Water quality improvement
  a. Sediment and debris removal
  b. Low-flow augmentation
"6. Ground water recharge
"7. Social impact
"8. Minimization of storm sewer-related facilities cost
"9. Reduction of long-term depreciation rate
"10. Flood plain encroachment."

WATER RIGHT APPROPRIATIONS UNDER DIFFERENT SEDIMENT REGIMES

Most of the dependable water of the State of Colorado for direct flow use was appropriated approximately 100 years ago. Then the farmer used an ox and the miner a pick. Horses pulled wagons to villages, served by water dippers and outhouses. Beavers built the dams. Now air-conditioned tractors plow hundreds of acres a day, miners tear down mountains and fill up valleys, freeways cross mountain passes, and skirt giant reservoirs and huge water treatment plants. No wonder sediment levels and pollution have to be reduced back toward earlier levels.

The study of sediments and other water pollutants is new for the most part.

Regular sediment measurements by the U.S.G.S. did not start until 1962 in Colorado. No one knows accurately the levels of sediment of the Arkansas River in the early days of Colorado's history when the main body of direct flow water was appropriated.

The first appropriations for water rights in the streams of the Eastern Slope were generally made in the early 1860's.

[4]Jones, D.E. and S.W. Jens (Co-chairman). Water and Metropolitan Man. Conference conducted by the Engineering Foundation and ASCE. (1969).

The non-Indian population was approximately 35,000. University of Northern Colorado, A Century of Colorado Census, Greeley, Colorado (1976). Mining was just beginning in the mountain watersheds, and the tailing piles and slag heaps had not yet begun to accumulate. Concentration of sediment and the amount of erosion were far lower than today.

Steinel wrote about changing stream characteristics in Colorado in History of Agriculture in Colorado, 1858-1925. On Page 217, he states:

> Streams Changed Their Character
>
> Changes that have occurred in the character of the Fountain, the Purgatoire and the Chico, due to the removal of protective forests on upper reaches of these streams and the ground cover adjacent to them, were described by Professor Carpenter in his testimony. He declared that the Fountain could once be spanned by an ordinary log, but that now it was several hundred feet wide. He said the same of the Purgatoire, and of the Chico that it had cut a deep channel into the plans. He said there were many little channels east of Pueblo that now are ten, fifteen or twenty feet deep, with vertical sides, cutting up the plains into a great many sections difficult to cross, which were not of that character in the early times. They were not channels at all then, but simply depressions.
>
> Deforestation Responsible.--"And these have been some of the changes," Carpenter declared, "that have taken place, due to the denudation of the forests and the grazing off of the grasses, both of which were protective."
>
> This has had the effect of modifying the flow of the Arkansas, according to his statement. "In the forest areas particularly the cutting off of the forests has not only changed the character, but has decreased the flow because of the wind effects; that is, by permitting the snow to evaporate. On the plains I am not quite so sure as to the sum of these influences; that is, whether it has so decreased the total quantity, but it certainly has changed the character of the water supply of the plains. "
>
> The Pueblo Flood.--That testimony was given in 1904. The disastrous Pueblo flood of 1921 owed some of its volume to the causes here described. This flood caused considerable loss of life, and

damage to the City of Pueblo and surrounding farm lands running into the millions. Foresters who examined the feeder streams after that flood were of the opinion that its severity was augmented by the fact that adjacent ground had been denuded of brush and grass and the drainage area at the headwaters stripped of trees. Entire farms were covered with silt, and reclamation of this land after the flood became a task requiring several years. Thus in the course of development physical features of the landscape, the very geography of the country, have been altered by the hand of man.

A general conclusion drawn from Steinel's work is that the sediment concentration of the Arkansas River has risen markedly since the days of the early water appropriations. How much it rose cannot be identified with accuracy. Development of a storage reservoir, such as Pueblo Reservoir on the Arkansas, decreases the sediment concentration downstream. How close the reservoir brings the sediment concentration of the downstream river to the early conditions is not known.

Post-reservoir sediment concentrations are closer to 1870 concentrations than were 1960 concentrations, after nearly 100 years of deforestation, mining and drainage basin development.

WATER USERS HAVE DIFFERENT WATER QUALITY NEEDS

Different water users want different water quality. It is for this reason that the Colorado Water Quality Commission has established various classifications of streams ranging from the warm water fishery to body contact recreation. The proposed Stream Water Quality Standards of the Colorado Department of Health, 1977, include the following classes:

<u>Recreation</u>
- Primary Contact
- Secondary Contact

<u>Aquatic Life</u>
- Cold Water Biota
- Warm Water Biota

<u>Agriculture</u>
- Irrigation and Stock

<u>Water Supply</u>
- Municipal and Private Ground Water Supplies
- Municipal Potable Surface Water

Municipal, domestic, industrial, and recreational water users all prefer to use water with low suspended sediment concentrations, low dissolved solids, and low counts of bacteria. When nitrogen in the form of nitrate exceeds 10 mg/l, it is no longer suitable for municipal use under state and federal health regulations. Industries prefer clean water with low sediment content and low dissolved solids. The ASCE, Vanoni, Vito A. (Editor), Sedimentation Engineering, ASCE Task Committee for the preparation of the Manual on Sedimentation, New York, N.Y., (1975), says:

> Sediment in transport affects the quality of water and its suitability for human consumption or use in various enterprises. Some industries cannot tolerate even the smallest amounts of sediment in water used for certain manufacturing processes, and the public pays a large price for removing sediment from water and in everyday life.

The Colorado Division of Wildlife, as well as many avid sportsmen, deal with fishery streams. They know that suspended sediment can kill fish and shellfish by clogging their gills and respiratory passages, destroy food organisms, and destroy spawning beds. High suspended sediment concentrations also reduce other recreational values of the water.

For agricultural use of water, ASCE states:

> In fact, the processes of sedimentation can create severe problems. Erosion, besides producing harmful sediment, may cause serious on-site damage to agricultural land by reducing fertility and productivity of soils.

Vanoni, Vito A., (Editor), Sedimentation Engineering. Irrigators using more efficient sprinkler or drip irrigation need clean water to avoid having sprinkler heads and drip orifices clogged.

Some agricultural irrigators may find benefits in water having a high nitrogen content because it is a crop nutrient. If these irrigators have ditch cleaning problems and related costs, they may prefer water with low sediment content. A few irrigators, like the Bessemer, have leaky ditches, and they may prefer water with high sediment content.

The Arkansas River is now classified as B_2 for warm water fisheries. Under the new standards of the Water Quality Control Commission, the Arkansas will be classified as Water Supply because of the city of Pueblo intake, as Agricultural, and for Aquatic Life. Portions of the river can be expected to be classified for recreation uses as well.

Pueblo Reservoir on the mainstem of the Arkansas River assists the State of Colorado in meeting stream water quality objectives for almost all of the various types of uses made of the water.

SETTING SEDIMENT STANDARDS IN RIVERS IS COMPLEX

In 1974, Colorado State University (CSU) convened a 21-member group of laymen and sediment experts to deal with the subject "Research Needs as Related to the Development of Sediment Standards in Rivers." The summary of the workshop was published with a position paper in March, 1975, by CSU under a Department of Interior grant.[5]

On Page 30 of the resulting report the author states:

> If indeed it is the purpose of standards for the sediment transport in rivers and streams to maintain the geomorphic and biotic equilibrium (or to re-establish such an equilibrium), we are faced with an almost insurmountable task.
>
> Standards must be set and enforced at the small streams else it becomes impossible to locate excessive sediment sources. Such standards need to be very sophisticated and must relate to the full grain size distribution of the moving sediment for geomorphic and biotic reasons.

Then, on Page 13, the position paper describes the impact of sediment on aquatic biota in the following manner:

[5] Gessler, Johannes. Research Needs as Related to the Development of Sediment Standards in Rivers. Colorado State University, Ft. Collins, Colorado (March 1975).

Sediment and Biota in the River. It is in a great variety of ways that sediment affects the stream biota. Accumulation of silt and fine sand on gravel and rubble stream beds may eliminate the spawning grounds of fish and the habitat of many aquatic insects which form the food supply for the fish. Of similar importance are the river bed characteristics like dunes and ripples since again they form preferred spawning grounds. Changes in the overall concentration may well eliminate or create dunes. Suspended sediment causes turbidity which reduces light penetration into the water and, therefore, reduces photosynthesis again significantly affecting the entire biota. Fish can tolerate high turbidities for short periods of times. But since fish productivity ultimately depends upon plant life and bottom fauna, any effects on those will eventually affect the fish biota.

The paper clearly emphasizes the need for controlling sediment loads on Pages 8 and 9.

Quite clearly in the case of sediment movement we are quickly approaching a situation of multiple point control: farm production requires minimizing soil losses, recreational groups demand elimination of suspended sediment, considered to be a pollutant, biologists realize the significant effect of suspended and bed load on the stream biota but have at this time apparently insufficient data to enter their demands for sediment control, yet are convinced of its necessity, and the morphologists (geologists and engineers) are just about to understand the extreme complexity of morphologic equilibrium and the devastating changes which can occur if the equilibrium is changed at some point in space and time.

DIVERSIONS AND SANDOUTS

Immediately below the river diversion works, most ditches have wasteways and sandouts. It is normal practice for irrigators to flush the upper end of their ditches because of sediment accumulations and resulting ditch clogging.

Every ditch diversion tends to increase the sediment concentration of the river water downstream because water is taken, but not a proportional amount of the sediment. Some return flow also introduces new sediment. Downstream diverters have more problems than upstream diverters because the sediment concentration is increased. This is best dramatized by the Rio Grande in New Mexico where there is not enough water left in the stream to carry the sediment. The bed of the Rio Grande is rising in most places as a result. At Albuquerque the stream bed is higher than portions of the city. High sediment concentrations in the Rio Grande have created the need for large federal expenditures in New Mexico to mitigate the adverse effects of increasing sediment concentrations due to the irrigators taking the water, but not the river sediment.

A reservoir, as a sediment trap, assists most users of water.

THE TOTAL DISSOLVED SOLIDS DILEMMA ON THE COLORADO AND ARKANSAS RIVERS: AN ANALOGOUS PROBLEM

About 100 years ago when the appropriation of water rights in the Arkansas and Colorado Basins began, the total dissolved solids (TDS) concentration was relatively low. Few extensive water users, diversions and reservoirs existed to concentrate the dissolved solids in the water.

Presently, the TDS levels in the Arkansas and Colorado Rivers continually rise downstream. McGregory, Dr. Robert F., Salinity May Stop Colorado From Using Its Own Colorado River Water, Wright Water Engineers, Denver, Colorado (1975). This rise is due to irrigation runoff, seepage, reservoir evaporation, and natural causes. Figures 4 and 5 illustrate this increase in TDS in the Colorado and Arkansas Rivers.

Note that the TDS concentration in the Arkansas River reaches nearly 4,000 mg/l at the Colorado-Kansas border. In the Colorado River at the Arizona-Mexico border the concentration reaches over 1,000 mg/l. By the state line, the Arkansas is far worse than the Colorado at the national border.

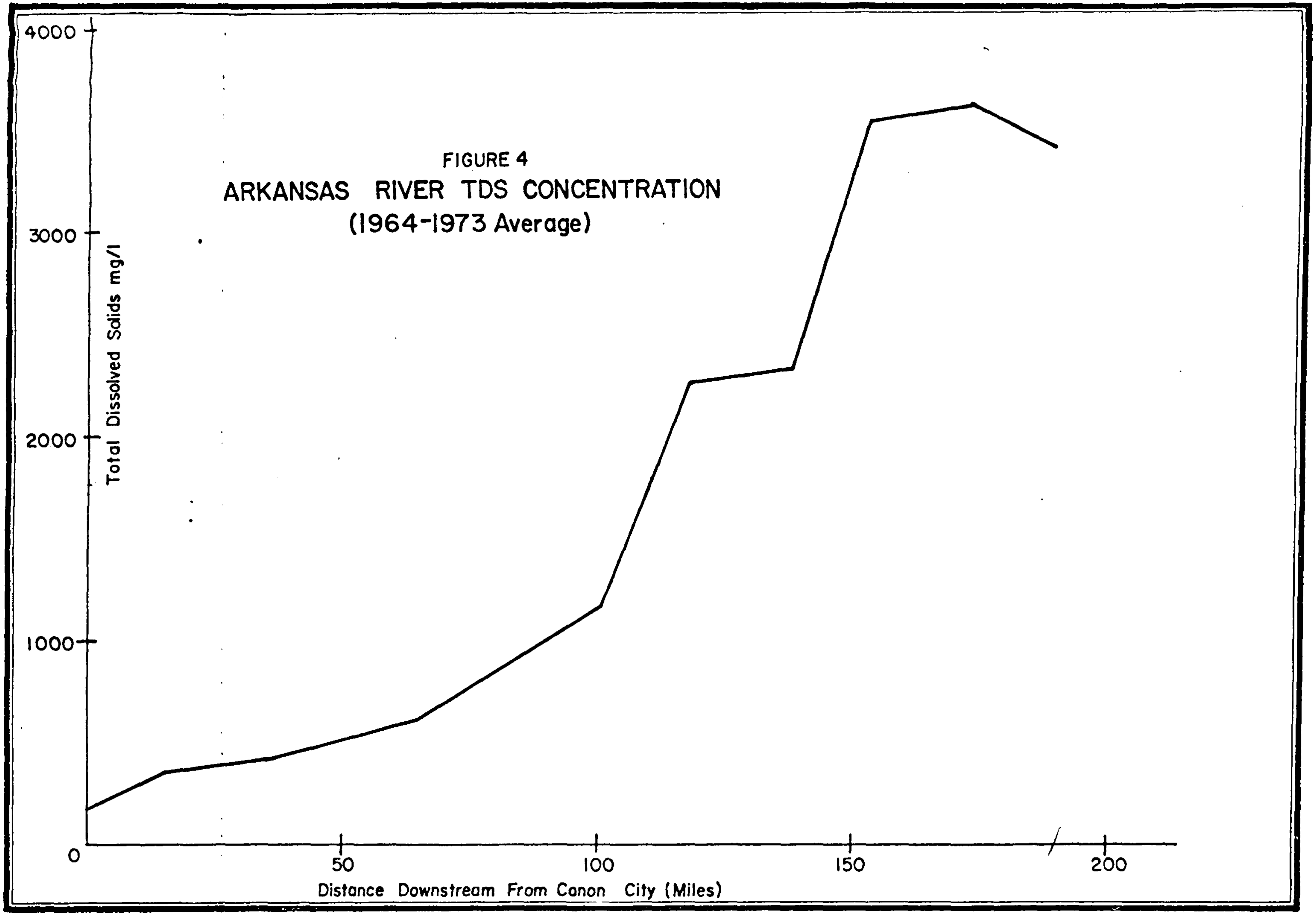
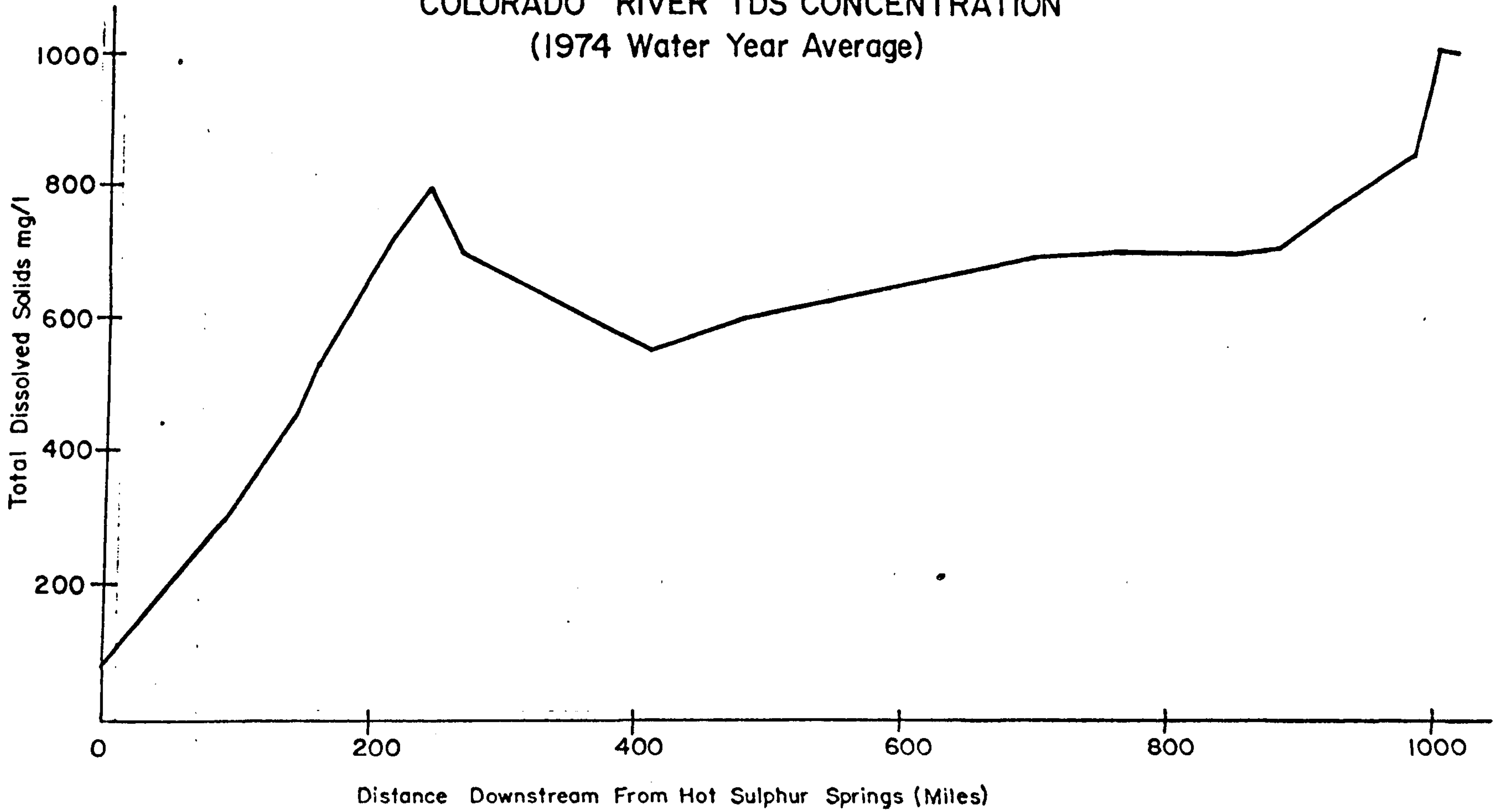


FIGURE 4
ARKANSAS RIVER TDS CONCENTRATION
(1964-1973 Average)
Total Dissolved Solids mg/l
4000
3000
2000
1000
0
50
100
150
200
Distance Downstream From Canon City (Miles)

Figure 5

COLORADO RIVER TDS CONCENTRATION
(1974 Water Year Average)



High salinity delays seed germination and reduces the crop yield. In the Arkansas Valley alone it is estimated that about $30 million per year is lost as a result of high salinity levels in the irrigation water. Miles, Donald L., Salinity in the Arkansas Valley of Colorado, Colorado State University for Environmental Protection Agency (May, 1977).

If irrigators are entitled to the same water quality as at the time of first appropriation, then downstream appropriators on both the Arkansas and Colorado Rivers are entitled to low TDS. This entitlement would in effect prevent upstream irrigation or require expensive desalination plants. For the Colorado River the U. S. Government has agreed to assist the Mexican Government in finding a partial solution to the TDS problem. However, the TDS will never be as low as when the Mexicans began their irrigation many years ago.

We suggest that to give a Colorado appropriator a right to a particular quality of water in regard to total dissolved solids would lead to economic and water chaos and be impossible to administer.

The same would hold true for suspended solids, i.e., suspended sediment. Would the State Engineer attempt to reforest the drainage basin and remove the mine tailings to reduce the sediment concentration for one appropriator, or would he attempt to remove existing dams to increase the sediment for another?

STATEWIDE IMPACTS

Water Resource Development Impacts

If appropriators are entitled to a specific water quality as well as quantity, new storage projects would be prevented and existing on-stream storage might have to be removed. This would force reverting to a flow-through system without the benefit of storage. Storage allows the more efficient use of the water by storing water in times of plenty for use during times of shortage. Water conservation and management is a way of life in Colorado and the West.

Each diversion and the return flow changes the water quality of a particular stream. A policy of granting a specific water quality to an appropriator requires the maintenance of status quo with respect to the existing water quality. For this reason transfers of water rights or changes in point of diversion would be precluded because of changes in water quality to other appropriators downstream.

In the agricultural sector development and implementation of improved irrigation techniques and runoff control would be inhibited because of possible water quality changes. In the municipal sector innovative wastewater treatment methods and sewage effluent exchange projects would be inhibited or eliminated.

Urban Development Impacts

A policy of granting a specific water quality to an appropriator which requires maintenance of the status quo with respect to water quality would prohibit most new construction or urban development. Construction and urban development increase suspended sediment and other pollutants below them. Berry, Brian J. L. and Frank E. Horton, Urban Environmental Management Planning for Pollution Control, Prentice-Hall, Inc., Englewood Cliffs, New Jersey (1974).

CLEAN WATER ANALOGY

Granting a specific water quality to an appropriator would conflict with the 1972 Federal Water Pollution Control Act Amendments. Because of this Act some municipalities are installing wastewater treatment systems beyond secondary treatment to remove ammonia, nitrogen, and phosphates from the water.

However, irrigators would not normally want these pollutants removed because of their fertilizer value. For this reason, granting a specific stream water quality to an appropriator could hinder wastewater cleanup efforts.

Figure 6 illustrates the rise in the total phosphorus concentration in the South Platte River after the wastewater discharge from the Denver Metropolitan Sewage Treatment Plant. (Colorado State Health Department, Storette Water Quality Data, South Platte River above Littleton and South Platte River at Henderson, 1974-1977.) The total phosphorus concentration is measured at two sites on the South Platte River. The first site is above Littleton. Note the low concentrations in the river at this point. The second site is at Henderson after the sewage effluent discharge has entered the river. The total phosphorus concentration is consistently 10 to 20 times greater at this site than above Littleton. Under PL 92-500 this additional phosphorus from the sewage discharge is to be eventually removed. However, irrigators might stop this cleanup from occurring because of its value to them.

Similarly, efforts to control point and non-point pollution, *i.e.*, industrial and municipal effluent, urban runoff and agricultural runoff, would be stymied. Granting a specific water quality to one ditch would not only conflict with federal laws and clean water goals but would also conflict with the State's stream and effluent standards.

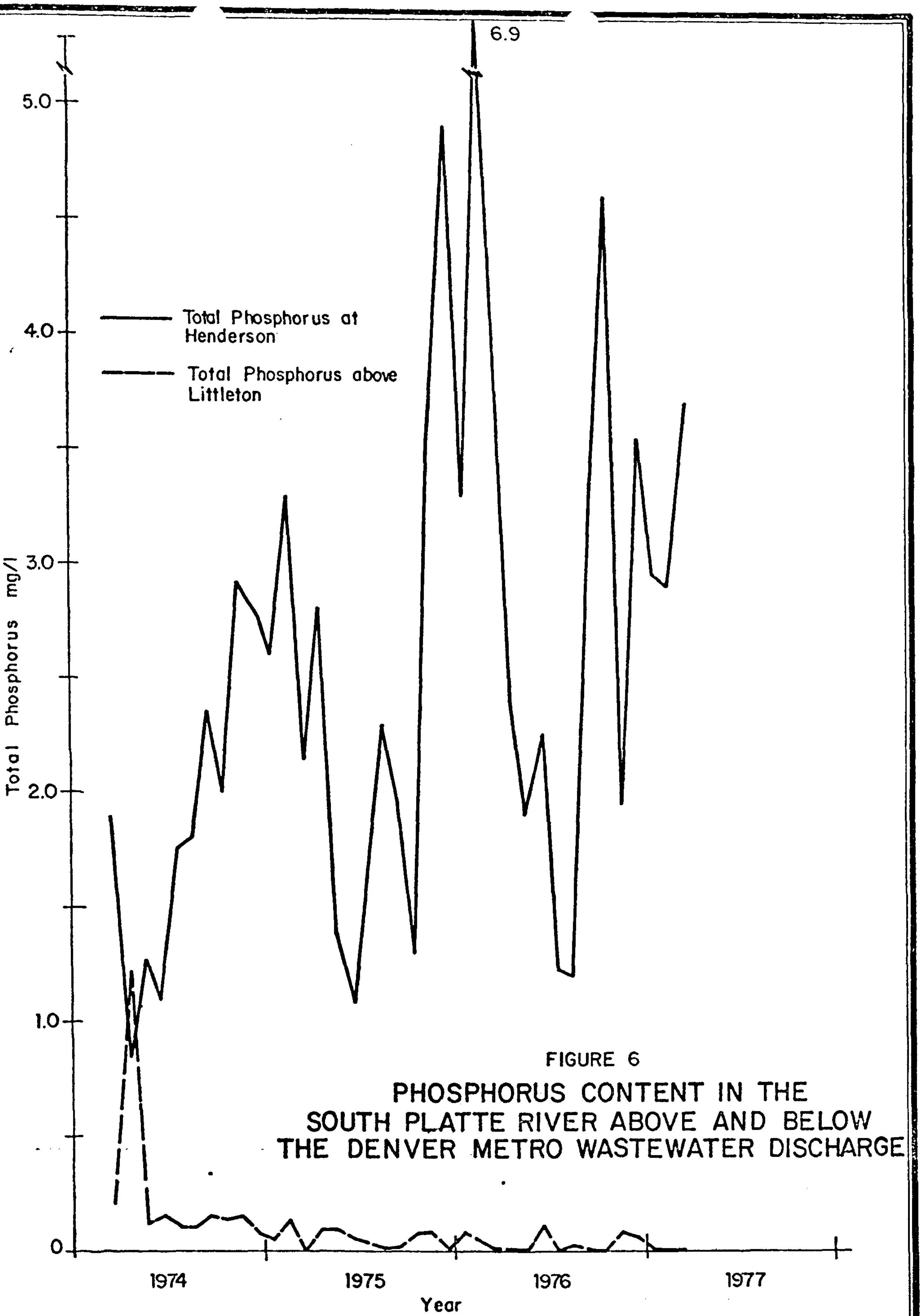


FIGURE 6

PHOSPHORUS CONTENT IN THE SOUTH PLATTE RIVER ABOVE AND BELOW THE DENVER METRO WASTEWATER DISCHARGE

RESPONSIBILITY OF USER TO BE EFFICIENT

Colorado water law demands efficient means of diversion. High seepage loss in a ditch reflects an inefficient means of diversion. Seepage losses are proportional to the wetted perimeter, depth of flow, length of the ditch, and permeability of the soils. U. S. Soil Conservation Service, SCS National Engineering Handbook, Section 15, Irrigation, Chapter 3, Planning, Farm Irrigation Systems, U. S. Department of Agriculture (1967).

In the U. S. Department of Agriculture 1955 Yearbook, Lauritzen wrote on the subject of inefficient canals. Lauritzen, C. W., "Ways to Control Losses from Seepage." The Yearbook of Agriculture 1955 - Water, U. S. Department of Agriculture (1955). He says:

> Considering the importance of water, it is worth emphasizing again that about one-third of all water diverted for irrigation is lost in conveying it to the land and that another third percolates too deeply or runs off during the process of application to the land. Some loss is a legitimate accessory to use, but losses of this order cannot long be tolerated.
>
> The major part of loss in conveyance can be attributed to seepage, which can largely be eliminated by lining the irrigation canals. Other conveyance losses, such as operational wastes, can be reduced by better management.
>
> Earth materials vary in their water-transmitting properties. Some coarse-textured materials are a million times more permeable than fine-textured soils. Within limits and with some exceptions permeability increases with the increase in the size of the particles of the material.

Lauritzen goes on to discuss sedimentation as a means to seal canals as follows:

> Sedimentation is another--but unsatisfactory--method of reducing seepage from canals with earth. It does not cut loss enough, and its effectiveness is temporary, because the sealing material is removed from the surface by scouring and the sealing effect is destroyed when it dries.

Inefficient irrigation techniques cause excessive water losses to seepage and deep percolation as well as runoff water quality problems. Sprinkler and drip irrigation have a higher field irrigation efficiency than other irrigation methods normally used in Colorado. Irrigation methods are compared below. Ditch losses to the point of application are not included in the efficiency percentage.

FIELD IRRIGATION EFFICIENCIES[6]

	Efficiency (%)
Contour ditch (flood irrigation)	40-60
Furrow	45-70
Sprinkler	70-80
Drip	80-90

Note that sprinkler and drip irrigation are approximately twice as efficient as flood irrigation. This reduces water quality problems of salinity, nitrates, and phosphates.

CONCLUSIONS

In the administration and management of water resources there is no basis for maintaining high suspended sediment concentration for the benefit of certain appropriators. Suspended sediment is a pollutant. Clean, high quality water is in the public interest. It is contrary to the public interest to maintain silt-laden waters to serve one water user while the public needs and demands clean water.

To attempt to maintain a suspended sediment concentration equal to the point in time when one's appropriation was made is impossible. Many appropriators would have different sediment concentration standards, because of the changing rates at which upstream erosion occurred due to land use practices in the early days. The first settlers and appropriators from 1859 and 1860 found a different suspended sediment content in the rivers than did those settlers and appropriators who followed during subsequent decades.

[6] Upper Colorado Region Comprehensive Framework Study, Appendix 10, Irrigation and Drainage Study. State and Federal Interagency Workgroup (1971).

Art. XVI, sec. 5, Colorado Constitution

and

Art. XVI, sec. 6, Colorado Constitution

IRRIGATION

Section 5. Water of streams public property. The water of every natural stream, not heretofore appropriated, within the state of Colorado, is hereby declared to be the property of the public, and the same is dedicated to the use of the people of the state, subject to appropriation as hereinafter provided.

Section 6. Diverting unappropriated water - priority preferred uses. The right to divert the unappropriated waters of any natural stream to beneficial uses shall never be denied. Priority of appropriation shall give the better right as between those using the water for the same purpose; but when the waters of any natural stream are not sufficient for the service of all those desiring the use of the same, those using the water for domestic purposes shall have the preference over those claiming for any other purpose, and those using the water for agricultural purposes shall have preference over those using the same for manufacturing purposes.

C.R.S. 1973, § 37-92-103(3),(4),(12),(13)

37-92-103. Definitions. As used in this article, unless the context otherwise requires:

(3) "Appropriation" means the application of a certain portion of the waters of the state to a beneficial use.

(4) "Beneficial use" is the use of that amount of water that is reasonable and appropriate under reasonably efficient practices to accomplish without waste the purpose for which the appropriation is lawfully made and, without limiting the generality of the foregoing, includes the impoundment of water for recreational purposes, including fishery or wildlife. For the benefit and enjoyment of present and future generations, "beneficial use" shall also include the appropriation by the state of Colorado in the manner prescribed by law of such minimum flows between specific points or levels for and on natural streams and lakes as are required to preserve the natural environment to a reasonable degree.

(12) "Water right" means a right to use in accordance with its priority a certain portion of the waters of the state by reason of the appropriation of the same.

(13) "Waters of the state" means all surface and underground water in or tributary to all natural streams within the state of Colorado, except waters referred to in section 37-90-103 (6).

C.R.S. 1973, § 25-8-101, et seq.
(Colorado Water Quality Control Act)

C.R.S. 1973, § 25-8-102 .
C.R.S. 1973, § 25-8-103(11)
C.R.S. 1973, § 25-8-103(12)
C.R.S. 1973, § 25-8-501 (as amended)

25-8-101. Short title. This article shall be known and may be cited as the "Colorado Water Quality Control Act".

Source: R & RE, L. 73, p. 709, § 1; C.R.S. 1963, § 66-28-101.

Law review. For note, "A Survey of Colorado Water Law", see 47 Den. L.J. 226 (1970).

25-8-102. Legislative declaration. (1) It is declared that pollution of state waters constitutes a menace to public health and welfare, creates public nuisances, is harmful to wildlife and aquatic life, and impairs domestic, agricultural, industrial, recreational, and other beneficial uses of state waters and the problem of water pollution in this state is closely related to the problem of water pollution in adjoining states.

(2) It is further declared to be the public policy of this state to conserve state waters and to protect, maintain, and improve the quality thereof for public water supplies, for protection and propagation of wildlife and aquatic life, and for domestic, agricultural, industrial, recreational, and other beneficial uses; to provide that no pollutant be released into any state waters without first receiving the treatment or other corrective action necessary to protect the legitimate and beneficial uses of such waters; to provide for the prevention, abatement, and control of new or existing water pollution; and to cooperate with other states and the federal government in carrying out these objectives.

(3) It is further declared that protection of the quality of state waters and the prevention, abatement, and control of water pollution are matters of statewide concern and affected with a public interest, and the provisions of this article are enacted in the exercise of the police powers of this state for the purpose of protecting the health, peace, safety, and general welfare of the people of this state.

(4) This article and the agencies authorized under this article shall be the final authority in the administration of water pollution prevention, abatement, and control. Notwithstanding any other provision of law, no department or agency of the state, and no municipal corporation, county, or other political subdivision, having jurisdiction over water pollution prevention, abatement, and control, shall issue any authorization for the discharge of pollutants into state waters unless authorized to do so in accordance with this article.

Source: R & RE, L. 73, p. 709, § 1; C.R.S. 1963, § 66-28-102.

25-8-103. Definitions. As used in this article, unless the context otherwise requires:

(11) "Pollutant" means dredged spoil, dirt, slurry, solid waste, incinerator residue, sewage, sewage sludge, garbage, trash, chemical waste, biological nutrient, biological material, radioactive material, heat, wrecked or discarded equipment, rock, sand, or any industrial, municipal, or agricultural waste.

(12) "Pollution" means the man-made, man-induced, or natural alteration of the physical, chemical, biological, and radiological integrity of water.

25-8-501. Permits required for discharge of pollutants - administration. (1) No person shall discharge any pollutant into any state water from a point source without first having obtained a permit from the division for such discharge. Each application for a permit duly filed under the federal act shall be deemed to be a permit application filed under this article, and each permit issued pursuant to the federal act shall be deemed to be a temporary permit issued under this article which shall expire upon expiration of the federal permit.

(2) The division shall examine applications for and may issue, suspend, revoke, modify, deny, and otherwise administer permits for the discharge of pollutants into state waters. Such administration shall be in accordance with the provisions of this article and regulations promulgated by the commission.

(3) The commission shall promulgate such regulations as may be necessary and proper for the orderly and effective administration of permits for the discharge of pollutants. Such regulations shall be consistent with the provisions of this article and with federal requirements, and shall be in furtherance of the policy contained in section 25-8-102, and may pertain to and implement, among other matters, permit and permit application contents, procedures, requirements, and restrictions with respect to the following:

(a) Identification and address of the owner and operator of the activity, facility, or process from which the discharge is to be permitted;

(b) Location and quantity and quality characteristics of the permitted discharge;

(c) Effluent limitations and requirements for treatment prior to discharge;

(d) Equipment and procedures required for mandatory monitoring as well as record-keeping and reporting requirements;

(e) Schedules of compliance;

(f) Procedures to be followed by division personnel for entering and inspecting premises;

(g) Submission of pertinent plans and specifications for the facility, process, or activity which is the source of a waste discharge;

(h) Restrictions on transfers of the permit;

(i) Procedures to be followed in the event of expansion or modification of the process, facility, or activity from which the discharge occurs or the quality, quantity, or frequency of the discharge;

(j) Duration of the permit, not to exceed five years, and renewal procedures;

(k) Authority of the division to require changes in plans and specifications for control facilities as a condition for the issuance of a permit;

(l) Identification of control regulations over which the permit takes precedence and identification of control regulations over which a permit may never take precedence;

(m) Notice requirements of any intent to construct, install, or alter any process, facility, or activity that is likely to result in a new or altered discharge;

(n) Effectiveness under this article of permit applications submitted to and permits issued by the federal government under the federal act.

(4) The commission may authorize temporary permits to be issued by the division pending completion of review procedures otherwise required prior to issuance of a permit, but no temporary permit may be issued for more than a period of two years nor shall any temporary permit be renewed.

(5) Nothing in any permit shall ever be construed to prevent or limit the application of any emergency power of the division.

(6) Every permit issued for a sewage treatment works shall contain such terms and conditions as the division determines to be necessary or desirable to assure continuing compliance with applicable control regulations. Such terms and conditions may require that whenever deemed necessary by the division to assure such compliance the permittee shall:

(a) Require pretreatment of effluent from industrial, governmental, or commercial facilities, processes, and activities before such effluent is received into the gathering and collection system of the permittee; and

(b) Prohibit any connection to any municipal permittee's interceptors and collection system that would result in receipt by such municipal permittee of any effluent other than sewage required by law to be received by such permittee;

(c) Include specified terms and conditions of its permit in all contracts for receipt by the permittee of any effluent not required to be received by a municipal permittee;

(d) Initiate engineering and financial planning for expansion of the sewage treatment works whenever throughput and treatment reaches eighty percent of design capacity;

(e) Commence construction of such sewage treatment works expansion whenever throughput and treatment reaches ninety-five percent of design capacity or, in the case of a municipality, either commence such construction or cease issuance of building permits within such municipality until such construction is commenced, except that building permits may continue to be issued for any construction which would not have the effect of increasing the input of sewage to the sewage treatment works of the municipality involved;

(f) Inclusion of the requirements authorized by paragraph (d) of this subsection (6) shall be presumed unnecessary to assure compliance upon a showing that the area served by a governmental sewage treatment works has a stable or declining population; but this provision shall not be construed as preventing periodic review by the division should it be felt that growth is occurring or will occur in the area.

(7) Every permit issued for a discharge from any facility, process, or activity that includes any dam, settling pond, or hazard within or related to its system shall include such terms and conditions as the division determines necessary to prevent or minimize the discharge of any pollutant into any state waters in potentially dangerous quantities.

(8) Repealed, L. 75, p. 883, § 2.

Source: (1) amended and (8) repealed, L. 75, pp. 879, 883, § § 2, 2.

Att C

COLORADO DEPARTMENT OF HEALTH

4210 EAST 11TH AVENUE • DENVER, COLORADO 80220 • PHONE 388-6111
Edward C. Dreyfus, M.D., M.P.H., Executive Director

NOTICE OF FINAL ADOPTION

Pursuant to the provisions of Section 24-4-103, Colorado Revised Statutes, 1973, as amended

NOTICE is hereby given that on March 18, 1975, the Colorado Water Quality Control Commission adopted certain rules subsequent to public hearings held pursuant to and in accordance with due and proper legal notice.

The Commission, after hearing all interested persons present, adopted the rules captioned as follows:

1. Regulations for Effluent Limitations

2. Regulations Prohibiting the Operation of A Sewage Treatment Works For Which a Site Approval Has Not Been Obtained

3. Regulations Prohibiting the Discharge of Certain Wastewaters to Storm Sewers and Prohibiting Certain Connections to Storm Sewers

Copies of said rules, as adopted by the Commission, are attached and made a part of this Notice.

The effective date of said rules will be twenty (20) days after the date upon which this Notice is published.

Dated this 1st day of August, 1975, at Denver, Colorado.

E. B. Pugsley

E. B. Pugsley, Ph.D., P.E.
Technical Secretary
Water Quality Control Commission

RADO DEPARTMENT OF HEALTH
r Quality Control Commission
E. 11th Avenue
er, Colorado 80220

ted: March 18, 1975
ctive: August 21, 1975

REGULATIONS FOR EFFLUENT LIMITATIONS

100. AUTHORITY. The Water Quality Control Commission is directed by C.R.S. 25-8-205, as amended, to promulgate control regulations, to describe prohibitions, standards, concentrations, and effluent limitations on the extent of specifically identified pollutants that any person may discharge into any specified class of state waters.

200. REGULATIONS.

(1) These effluent limitations for the discharge of wastewaters shall pertain to all wastewater discharges, except storm runoff waters and agricultural return flows, into any state waters. "State waters" means any and all surface or subsurface waters which are contained in or flow in or through this state, except waters in sewage systems, water in treatment works of disposal systems, water in potable water distribution systems, and all water withdrawn for use until use and treatment have been completed.

(2) No person (except as provided in subparagraph (3) below) shall discharge any wastewaters into any state waters if such wastewaters violate any of the specific limitations contained in paragraph 300 below, applicable to such wastewaters, unless the discharge is covered by a discharge permit containing a compliance schedule which will bring the discharge into compliance with the effluent limitations, according to a planned schedule.

(3) At such time as effluent limitation guidelines are promulgated by the Commission for an industry pursuant to Section 25-8-205(2)(d), C.R.S., as amended, such industry shall be subject to those guidelines and shall not be subject to effluent limitations set forth below in paragraph 300. If the Commission has not so promulgated effluent limitation guidelines for any particular industry but that industry is subject to effluent limitation guidelines promulgated by the United States Environmental Protection Agency pursuant to the Federal Water Pollution Control Act of 1972, an effluent from these industries shall be subject to the applicable EPA guidelines and shall not be subject to the effluent limitations of paragraph 300 below.

(4) The effluent limitations set forth below, or promulgated according to subparagraph (3) above, are also subject to being superseded or augmented when it is found that stricter limitations are required in order to maintain water quality or to bring a receiving water up to its prescribed water quality standards.

300. SPECIFIC LIMITATIONS FOR THE DISCHARGE OF WASTES.

PARAMETERS	PARAMETER LIMITATIONS	
	7-Day Average	30-Day Average
BOD_5	45 mg/l*	30 mg/l*
Suspended Solids	45 mg/l*	30 mg/l*
Fecal Coliform	As determined by the Division of Administration of the State Health Department to protect public health in the stream classification to which the discharge is made	
Residual Chlorine	Less than 0.5 mg/l**	
pH	6.0 - 9.0**	
Oil and Grease	10 mg/l and there shall be no visible sheen**	

*Analyses of wastewater discharges for BOD_5 and suspended solids shall be based on the following:

(a) Samples: If samples are taken at the outfall of a final quiescent pond, with at least 48 hours detention, the sample may be a grab sample. In all other plants, samples shall be a composite sample, comprised of a minimum of four grab samples taken approximately two hours apart.

(b) 7-Day Average: The arithmetic mean of a minimum of three samples taken on separate days in a 7-day period.

(c) 30-Day Average: The arithmetic mean of a minimum of three or more samples collected in separate calendar weeks during a 30-consecutive-day period with a minimum of 20 days occurring between the first and last sample days.

(d) In addition to the above effluent limitations, the arithmetic mean of the values for effluent samples collected in a period of 30 consecutive days shall not exceed 15 percent of the arithmetic mean of the values for influent samples collected at approximately the same time during the same period (85 percent removal).

(e) These numerical limits and sampling requirements have been set with the inherent variability of the analytical procedures taken into consideration.

**A single grab sample shall be used for residual chlorine, pH, and oil and grease.

COLORADO DEPARTMENT OF HEALTH
Water Quality Control Commission
210 E. 11th Avenue
Denver, Colorado 80220

April 11, 1977

#712-12

DRAFT #6

P R O P O S E D

WATER QUALITY STANDARDS FOR COLORADO

AUTHORITY: These standards are promulgated pursuant to Sections 25-8-202(1)(b)(c); 25-8-203; 25-8-204; 25-8-205(3), C.R.S. 1973, as amended.

PURPOSE: The standards are the foundation for the classification of the waters of the State of Colorado, as defined in the Water Quality Control Act and are intended to implement the state act by maintaining and enhancing the quality of the state's waters. Standards are chosen in accordance with the best available knowledge to insure the suitability of Colorado's waters for beneficial uses including public water supplies, domestic, agricultural, industrial, and recreational uses, and the protection and propagation of terrestrial and aquatic life. They are further intended to be consistent with the 1958 goals and the 1983 objectives of the Federal Water Pollution Control Act Amendments of 1972, which are stated in Section 101 thereof. These standards shall be construed in a manner consistent with these purposes and shall be considered the numerical

40,10,73 implementation of the 1983 objectives.

INTRODUCTION

31 Part I of these Water Quality Standards presents a system which establishes

40 beneficial use categories together with numerical criteria which define the conditions necessary to maintain such beneficial uses. Part II implements the standards by applying the system to specific waters of the state, including surface and ground waters. Whenever a specific stream segment or body of water receive a classification for one or more of the uses, the corresponding numerical criteria become applicable. Water quality standards shall be reviewed not less than once every three years and revised where appropriate as required

	PARAMETER	RECREATIONAL: Primary Contact (Ingestion)	RECREATIONAL: Secondary Contact (Recreational other than Primary)	AQUATIC LIFE: Cold Water Biota	AQUATIC LIFE: Warm Water Biota	AGRICULTURE: Irrigation & Stock	WATER SUPPLY: Municipal & Private Ground Water Supplies (1)	WATER SUPPLY: For Municipal Potable Surface Water (Raw Water) (2)
5	**Physical**							
2	D.O. (mg/l)	x	x	68 7.0	5.0	x	x	---
	pH (S.V.) 68	6.5 - 9.0	x	6.5 - 9.0	6.5 - 9.0	x	x	5.0 - 9.0
7	Suspended Solids (3) (mg/l)	x	x	68 25 (3)	25 (3)	x	x	---
7,29,15	Temperature (°C)	x	x	Max. 20° C w/3°C Change (4)	Max. 30° C w/3°C Change (4)	x	x	---
8	TDS (mg/l) (7)	x	x	x	x	x (5)	x (5)	x (5)
	Pollutional Indicators (6) (Levels indicated here represent pollution warnings calling for special investigation to identify sources.)							
8	Total Ammonia/Ammonium (7) as $NH_3 + NH_4^+$ (mg/l as N)	5.0	5.0	5.0	5.0	---	x	5.0
6	BOD_5 (mg/l) (8)	5.0	5.0	5.0	5.0	---	x	5.0
	Nitrate (mg/l as N) (9)	4.0	4.0	4.0	4.0	x	x	4.0
7	Total Phosphorus (mg/l as P)	.025 Lake 0.1 Stream	.025 Lake 0.1 Stream	.025 Lake 0.1 Stream	.025 Lake 0.1 Stream	x	1.0	1.0 Stream

(1) Ground water supplies where there is no treatment except for disinfection before use for drinking water purposes. Assume aquifers are directly recharged by surface streams, such as South Platte River, Clear Creek, Bear Creek, Arkansas River, etc.

(2) These water supplies normally receive coagulation, sedimentation, filtration, and disinfection prior to use in the municipal system.

(3) 25 mg/l for stream segment attributable to municipal, industrial, agricultural, construction (including highways), and reservoir draining.

L, (4) Temperature shall maintain a normal pattern of diurnal and seasonal fluctuations with no abrupt changes and shall have no more than a 3° C. change from the naturally occurring temperature, attributable to municipal, industrial, or other discharges or agricultural practices. The maximum shall not be exceeded by other than natural causes.

38,1 (5) See Page _____ Section

(6) These parameters in the given use classes are pollutional indicators. Should the parameters reach the indicated levels in the waters of Colorado, it is probable that environmental degradation is occurring. The numerical levels should not be construed as stream standards but as indications of problems requiring investigation to determine the cause and effect upon the waters.

(7) While ionized ammonium is not toxic, total ammonia is an indicator of pollution which should be a basis for signaling need for pollution control.

(8) The listed BOD_5 value of 5 ppm nears the minimum reproducible value and takes into consideration the built in systematic errors of the procedure.

(9) A level of NO_3 Nitrogen above 4.0 mg/l is an indication of pollution sources which would signal the need for more detailed investigation.

(10) Where a pollutional constituent was considered not to apply, or where the constituent concentration could be high without unacceptable hazards being involved, an "X" has been inserted in lieu of a number.

(11) Where too little is known about the adverse effects of a pollutional constituent [illegible]

C.R.S. 1973, § 37-84-101

37-84-101. Maintenance of embankments and tail ditch. The owners of any ditch for irrigation or other purposes shall carefully maintain the embankments thereof so that the waters of such ditch may not flood or damage the premises of others, and shall make a tail ditch so as to return the water in such ditch with as little waste as possible into the stream from which it was taken.

Source: G. S. § 1728; R. S. 08, § 3233; C. L. § 1713; CSA, C. 90, § 111; CRS 53, § 147-7-1; C.R.S. 1963, § 148-7-1.

C.R.S. 1973, § 37-84-107

37-84-107. Owner of ditch must prevent waste. The owner of any irrigating or mill ditch shall carefully maintain and keep the embankments thereof in good repair and prevent the water from wasting.

Source: L. 1876, p. 78, § 1; G. L. § 1385; G. S. § 1733; R. S. 08, § 3238; C. L. § 1719; CSA, C. 90, § 117; CRS 53, § 147-7-7; C.R.S. 1963, § 148-7-7.

Fryingpan-Arkansas Act, 43 U.S.C.A. 616(a)

FRYINGPAN-ARKANSAS PROJECT, COLORADO

§ 616. Authorization of project—Purposes; construction, operation and maintenance; modification of plans; exportation of water from the Colorado River system; law governing

(a) For the purposes of supplying water for irrigation, municipal, domestic, and industrial uses, generating and transmitting hydroelectric power and energy, and controlling floods, and for other useful and beneficial purposes incidental thereto, including recreation and the conservation and development of fish and wildlife, the Secretary of the Interior is authorized to construct, operate, and maintain the Fryingpan-Arkansas project, Colorado, in substantial accordance with the engineering plans therefor set forth in House Document Numbered 187, Eighty-third Congress, modified as proposed in the September 1959 report of the Bureau of Reclamation entitled "Ruedi Dam and Reservoir, Colorado", with such minor modifications of, omissions from, or additions to the works described in those reports as he may find necessary or proper for accomplishing the objectives of the project. Such modifications or additions as may be required in connection therewith shall not, however, extend to or contemplate the so-called Gunnison-Arkansas project; and nothing in sections 616–616f of this title shall constitute a commitment, real or implied, to exportations of water from the Colorado River system in Colorado beyond those required for projects heretofore or herein authorized. In constructing, operating, and maintaining the Fryingpan-Arkansas project, the Secretary shall be governed by the Federal reclamation laws (Act of June 17, 1902; 32 Stat. 388, and Acts amendatory thereof or supplementary thereto).

The waters of the upper Arkansas River Basin are presently over-appropriated and there are serious losses in crop production on the presently irrigated farmland. Supplemental water supplies are necessary to stabilize the agricultural economy in the area. The 280,000 acres which would benefit from this project now have an inadequate or undependable supply of water. Numerous irrigation ditches have no water until May and many have none after early August. Pumping from ground water to supplement surface supplies has been expanded to the limit of available recharge. Crop losses on irrigated lands have been severe in recent years, with the irrigated area unable to produce sufficient livestock feed for its own use. It is estimated that timely releases of project water during critical crop-growing periods, amounting to an average of 0.6 acre-foot for the 280,000 inadequately irrigated acres, will cut the long-term average yearly irrigation shortages in half—that is, from 32 to 16 percent, which is tolerable.

Municipal water needs in the Arkansas Valley have become critical. Diminishing water supplies and the rapid population growth in Pueblo, Colorado Springs, and other valley cities and towns have contributed to this critical water supply situation. A U.S. Public Health Service study in 1957 indicated that the Arkansas River is one of the worst in the Nation from the standpoint of pollution, chloride content, alkalinity, hardness, and turbidity. Transmountain diversion is the only source of any appreciable amount of water to meet the municipal needs unless the already short agricultural water supply is diverted to muncipal use, thus further disrupting the agricultural economy of the area. The new supply from the Fryingpan-Arkansas project would go a long way toward improving the water quality and meeting the critical need for additional muncipal water.

Flood control is a very important aspect of the Fryingpan-Arkansas project. Floods in the upper Arkansas River Valley annually threaten the loss of propery and discourage investment. Damaging floods occur almost every year. The worst flood on record occurred in 1921 when at least 78 persons lost their lives and property damage exceeded $19 million. There has been some improvement along the lower Arkansas River due to construction of the John Martin Reservoir in 1949, but the flood danger still exists upstream, particularly between Pueblo and the John Martin Reservoir. The Fryingpan-Arkansas project would prevent a large part of the flood damages that occur annually along that stretch of the river.

The needs for electric power and energy in the project area are expanding rapidly, and increased demands are overtaxing existing facilities. The additional supplies of electric power and energy from the Fryingpan-Arkansas project will help meet these ever-increasing demands.

Sediment control, pollution control, protection and enhancement of fish and wildlife values, and additional recreational opportunities are also needs in the project area which will be fully or partially met through the construction of the Fryingpan-Arkansas project.

In summary, it can be said that the most pressing and immediate needs of the upper Arkansas Valley can be met by construction and operation of the Fryingpan-Arkansas project as proposed in S. 284.

CHAPTER VIII. SEDIMENT CONTROL

EXISTING SEDIMENT PROBLEMS

In the diversion area and on the eastern slope above Canon City sedimentation is negligible. The irrigated section of the Arkansas River between Pueblo and the John Martin Reservoir, however, has many sediment problems. Sediment that has been removed from canals now lines the canal banks and further disposal has become an expensive process. Aggradation of the river channel in the vicinity of diversion structures has either made those structures inoperative or necessitated their being raised. Various canal sand traps have been made inoperative. Reservoir capacities are being depleted and feeder canals supplying off-channel reservoirs have become clogged with sediment causing loss in canal capacities of as much as 50 percent in some instances. A considerable amount of sediment is being deposited in laterals and on the irrigated lands. Below the John Martin Reservoir very few sediment problems are evident.

POTENTIAL SEDIMENT CONTROL

In determining the average annual sediment yield that might be expected from the drainage area above the Pueblo Dam site, the flow-duration-sediment rating curve method of analysis was used. A rating curve of sediment discharge for given flows for the period of sediment data record and a flow duration curve of water discharges for the period of water record were developed. From these curves the average annual sediment load was determined. By preparing 2 flow duration curves, 1 for rain and 1 for snowmelt, and base flows, separate sediment load determinations were made. The computed sediment loads were then combined to give an estimated average total sediment load of 944 acre-feet per year at Pueblo Dam site with a suspended load of 834 acre-feet. Past diversions of the Bessemer ditch, which diverts above the damsite, averaged about 10 percent of the river flow at the damsite. As the new outlet for the ditch would be at the damsite, about 10 percent of the suspended load would be added to the 944 acre-feet of sediment contribution to the Pueblo Reservoir. Operation of the John Martin and other reservoirs by the Corps of Engineers, however, indicates that about 10 percent of the suspended sediment would be sluiced through the reservoir. Thus, the total annual sediment contribution to Pueblo Reservoir would remain 944 acre-feet and a total of 94,400 acre-feet of storage capacity would be required for the 100-year period.

Data from existing reservoirs in which sedimentation has occurred were used to estimate the manner in which sediment would be deposited in Pueblo Reservoir. At the end of 100 years sediment deposition at Pueblo Dam could be expected to be 15 feet above the original stream bed elevation. Based on a total capacity of 400,000 acre-feet, the allocation of capacity at the end of 100 years of operation would be as follows:

Storage	*Acre-feet*
Flood control	93, 000
Water conservation	210, 600
Sediment	94, 400
Dead storage [1]	2, 000
Total	400, 000

[1] 10,000 acre-feet less 8,000 acre-feet sediment in the dead-storage pool.

BENEFITS

Of the 944 acre-feet of sediment which would enter Pueblo Reservoir annually, it is estimated that below that reservoir 751 acre-feet would be prevented from being deposited in the existing reservoirs, canals, laterals, and on irrigated lands. No attempt is made to evaluate benefits for preventing deposition on irrigated lands. Total annual benefits are estimated to be $141,300 (table 10).

TABLE 10.—*Estimated annual sediment benefits, Pueblo Reservoir*

Point of deposition or pickup	Dollar benefits per acre-foot sediment stopped from depositing	Estimated annual sediment stopped from depositing (acre-feet)	Annual benefits
Bedload pickup	(1)	110	
Suspended load pickup	(1)	83	
John Martin Reservoir:			
Irrigation storage	$329	104	$34, 200
Flood control	43	52	2, 200
Off-channel reservoirs	329	60	19, 700
Canals	160	89	14, 200
Laterals	800	89	71, 000
Irrigated land	(2)	357	
Total		944	141, 300

[1] No benefits.
[2] Not evaluated.

Federal Water Pollution Control Act, 33 U.S.C. 1251(a) and (b)

SUBCHAPTER I—RESEARCH AND RELATED PROGRAMS

§ 1251. Congressional declaration of goals and policy

(a) The objective of this chapter is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. In order to achieve this objective it is hereby declared that, consistent with the provisions of this chapter—

(1) it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985;

(2) it is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983;

(3) it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited;

(4) it is the national policy that Federal financial assistance be provided to construct publicly owned waste treatment works;

(5) it is the national policy that areawide waste treatment management planning processes be developed and implemented to assure adequate control of sources of pollutants in each State; and

(6) it is the national policy that a major research and demonstration effort be made to develop technology necessary to eliminate the discharge of pollutants into the navigable waters, waters of the contiguous zone, and the oceans.

(b) It is the policy of the Congress to recognize, preserve, and protect the primary responsibilities and rights of States to prevent, reduce, and eliminate pollution, to plan the development and use (including restoration, preservation, and enhancement) of land and water resources, and to consult with the Administrator in the exercise of his authority under this chapter. It is further the policy of the Congress to support and aid research relating to the prevention, reduction, and elimination of pollution, and to provide Federal technical services and financial aid to State and interstate agencies and municipalities in connection with the prevention, reduction, and elimination of pollution.

I hereby certify that I mailed a true and correct copy of the foregoing BRIEF OF AMICI, SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT, COLORADO RIVER WATER CONSERVATION DISTRICT, SOUTHWESTERN COLORADO WATER CONSERVATION DISTRICT, LOWER SOUTH PLATTE WATER CONSERVANCY DISTRICT; AND APPENDIX OF AMICI, SOUTHEASTERN COLORADO WATER CONSERVANCY DISTRICT, COLORADO RIVER WATER CONSERVATION DISTRICT, SOUTHWESTERN COLORADO WATER CONSERVATION DISTRICT, LOWER SOUTH PLATTE WATER CONSERVANCY DISTRICT; with postage prepaid, to those listed below this 25th day of October, 1977.

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