

Bays and Estuaries and the Texas Water Plan

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Abstract

The Texas Water Development Board and the Texas Water Quality Board have among their common goals the improved quality of our bays and estuaries and their preservation and enhancement, thereby assuring future generations of Texans a heritage that will contribute to their economic, aesthetic and recreational well-being.

A principal recommendation of the Texas Water Plan is a broadly based study of the hydrologic and structural requirements for the continued use, development and enjoyment of these waters. This study will be directed toward determining the characteristics of the bays, finding alternatives to permit maximum use of the water resources of the bays, and studying the economic relationship of the various uses of the bay system now and in the future. The study will be concerned with the hydrology of the bay system and the possibilities of hydraulic or structural modification which might improve nursery and spawning grounds of the diverse fish population.

The Texas Water Plan proposes to use Gulf water as much as possible to minimize needs for reservoir fresh water releases in the preservation of the bay system. A proposed diversion system, spanning 980 miles from northeast Texas to south Texas, would provide annually 2,450,000 acre feet of fresh water for the bays and estuaries.

TEXANS HAVE BEEN KNOWN to brag about their State's bigness, about having more of this and more of that. These Texas boasts have fashioned an image that is not always accurate and one that omits a major dimension. Texas is big, although we now bow to our sister State of Alaska and gracefully recognize that we are second in size, but Texas is also a state of contrasts.

These contrasts produce many complexities unfamiliar to other states. Our land elevation varies from sea level to 8,750 feet at Guadalupe Peak near El Paso. Annual rainfall ranges from 56 inches along the southeastern Gulf region to about 8 inches in far West Texas. Sub-freezing weather can chill the High Plains while the Rio Grande Valley basks in semitropical warmth. Wheat, cotton, corn, sugar beets and grain sorghums thrive in irrigated West Texas while vegetables are produced in the winter garden area west of San Antonio.

Rice is produced along the Gulf Coast and citrus fruit ripens in the southern valley. Pine and hardwood forests cover the rolling hills in the east while cactus, mesquite and low brush dot the unwatered sands of the west. Despite more than 130 major surface reservoirs with storage capacities in excess of 5,000 acre-feet, 80 percent of all water used in the State comes from underground.

More complex problems are generated by our 23 river basins, ranging from the Lavaca River Basin which embraces one county and portions of six others to the Brazos River Basin which spans the State from New Mexico to the

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Gulf of Mexico. Too, we must consider our interstate rivers governed by compact — the Sabine, Canadian, Pecos, and the Rio Grande, an international river forming the boundary of the United States and Mexico and crossing the States of Colorado and New Mexico. Negotiations have been under way for 10 years with Louisiana, Arkansas, and Oklahoma to form a compact for the Red River, Texas' northern boundary.

Rapid industrialization and urbanization of the State caused a change in the historical social, political, and economic relationships which characterize Texas. These diversities present a wide range of problems or opportunities, depending upon how you view them.

It is said there are enough water plans either for the entire State of Texas or some of its area to pave a four-lane highway from Texarkana to El Paso, more than 800 miles to the west. Then why are we now preparing another plan?

The distribution of our water supply doesn't match the distribution of our people and their needs, and this maldistribution will be aggravated as time passes. One-third of all water used in Texas annually is used for irrigation on the High Plains from the Ogallala underground aquifer, and this water is being mined. What happens when the supply is exhausted? What of the future supplies for our inland cities, their people and industry?

The drought of the 1950's and the floods that followed provided strong impetus to broad-scale water planning in Texas. Never in the history of Texas has the State in so short a span suffered such severe drought terminated by such massive floods.

The rapid growth of Texas since World War II, its expanding industry, increased agriculture and burgeoning urbanization have all placed demands on the State's water supplies and have increased the problems of meeting these demands. In 1964, Governor Connally expressed his concern about drought conditions and progress of efforts to develop adequate sources of water for all the State. He directed the Water Commission "... in the public interest and to aid the economic growth and general welfare of the State . . ." to develop a water plan for Texas "longer in range and broader in scope than previous plans," which he felt were inadequate to satisfy all the water needs for Texas.

Thus began what has been characterized by non-Texans, presumably free of a suspected chauvinistic bias, as the most comprehensive state water plan ever undertaken.

I would be less than honest if I did not tell you that until 25 months ago my interest in fish was generally confined to baiting a hook at the side of a Texas stream, on a Texas lake, or on the Gulf. During these past months my interest in marine life has been increased immeasurably by the two positions I now have in State government — Executive Director of the Texas Water Development Board and Chairman of the Texas Water Quality Board, the successor to the Texas Water Pollution Control Board.

Although the Water Development Board and the Water Quality Board are separate and independent agencies of the State of Texas, they have among their common goals the improved quality of our bays and estuaries and their preservation and enhancement. Both Boards are dedicated to these goals and each is working earnestly and energetically to assure future generations of Texans a heritage that will contribute to their economic, aesthetic and recreational well-being.

How successful we will be in attaining these goals depends, of course, upon the people of our large and complex State and their willingness to accept the

responsibility for the development of Texas' water resources for the common welfare rather than by locality, region or area, as in the past. We must put aside the restrictions that have limited our provincial views. We must accept the fundamental fact that the welfare of the people of the whole State is paramount and that each person will benefit as the State as a whole benefits. We must accept the premise that what is good for West Texas and what is good for East Texas must be harmonized for the good of all of Texas and recognize, to paraphrase an adage, that the State of Texas is as strong as its weakest region. We must recognize and accept that as Texans, planning and working together, we can solve the problems which confront us.

I believe we are making progress in bringing about an understanding of the need for developing our water resources on a statewide basis. Many of the barriers that frustrated the efforts of past planners have been breached. Many of the prejudices and fears of the past have been overcome. Many of the divisive voices have been moderated. I do not mean to imply that harmony reigns throughout Texas. Rather, I would say we are undergoing a period of constructive tension awaiting presentation of the Texas Water Plan.

Throughout the 30 public hearings and meetings that followed release of the Preliminary Plan on May 30, 1966, the concept of a statewide plan was applauded in every section of the State, but there was, however, disagreement in many sections of Texas with some of the Plan's details.

Since the hearings were concluded more than a year ago, the Board has been pursuing a program of work examining in as much detail as is logical and feasible each of the many alternatives, suggestions, criticisms, and proposals for modification of the Preliminary Plan.

The Board's studies and reevaluations are nearing completion, and the Texas Water Program, designed to provide ample water to the year 2020 when the State's population is expected to reach 30.5 million, will be released early next year.

It is estimated that the construction cost of the Program, complete with its 53 dams and reservoirs and massive transportation facilities to provide water for West Texas, the Trans Pecos, El Paso, the High Plains, the Winter Garden, South Texas, the Rio Grande Valley and for Texas' bays and estuaries, will require an investment of \$5 to \$7 billion.

The Texas Water Resources Administration Act requires the Texas Water Development Board to give "Consideration . . . in the Plan to the effect of upstream development upon the bays, estuaries, and arms of the Gulf of Mexico and to the effect upon navigation. . ."

Throughout the entire planning period, strong emphasis has been placed on providing for the preservation and enhancement of our bay and estuary environment. This has been a basic tenet of the Texas Water Development Board. It is inextricably woven into the fabric of the Texas Water Plan.

Use of the bays for navigation, dredging, commercial and sports fishing, oil and gas production, maintenance and propagation of marine life and recreation is extensive. An analysis of these activities indicates their major contribution to the viability of the State's economy. The entire recreational complex developed around these bodies of water and the potential future development are important planning considerations. Boating, swimming, water skiing, camping, summer and tourist housing all contribute to the economic and cultural value of the bays.

Pending a complete inventory and evaluation, some indication of the

astonishing order of magnitude of the value of these estuaries for recreation and sport and commercial fishing alone is suggested by an extrapolation of the annual value of \$370 per acre of bay surface area estimated in 1958, almost a decade ago, for the Corpus Christi area. This is the sum of all averages of all tangible and imputed surface acre values associated with all present activities related to the bays. These include recreation and sport fishing at \$151; commercial fishing at \$15; minerals at \$130; cooling water at \$10; transportation at \$63; and effluent disposal at \$1 value per bay surface acre per year.

For want of complete coverage of the bays, and as an exercise, if this value is applied to the 1.3 million acres of Texas coastal bays, the total annual value would be \$483 million. Applying one of the basic formulas of mathematics of finance, when computed as an annuity of \$483 million annually at 5 percent for 50 years, the present worth of all the bays is \$8.8 billion or \$6,780 an acre.

These values, taken from a study by the Bureau of Business Research and Institute of Marine Science at the University of Texas, are perhaps now obsolete and understated. However, they are an indication of the economic value to the State of Texas and her citizenry and clearly establish, I believe, the necessity to save these aspects of the bays and estuaries.

The complexities of the Texas bay system and the dearth of authoritative information have provided tasks of Herculean proportions. The bays, which lie in a broad arc of approximately 375 miles, pass through a variety of climatic regions, causing them to range from too salty to too fresh. Baffin Bay and Upper Laguna Madre, southwest of Corpus Christi, are too salty while Galveston Bay sometimes has too much fresh water, and Sabine Lake, at the tip of Texas, is overwhelmed by fresh water.

Initial estimates of large fresh water need for estuaries would not permit reasonable river development of the Texas Water Plan. Some of these estimates ran as high as 20 million acre feet annually.

Historically, fresh water inflows into the bays have wide seasonal variations, ranging from severe droughts to major floods. We have had a recent example of heavy inflows into some of our bays. Massive floods caused by Hurricane Beulah turned normal saline Corpus Christi and Matagorda Bays into "fresh water." It is not yet known to what extent the ecological balance of these bays has been changed.

Each of the major bay and estuary systems has varying-sized navigation facilities which require periodic maintenance. The Water Development Board recognizes that as further industrial development occurs, new navigation facilities will be required or existing channels enlarged.

In places, Texas estuaries are being choked with pollution and spoil from dredging operations.

The Water Development Board, in its planning, has been aware of the effects of siltation upon marine life in the bays. The main sources of siltation are river floods, shore erosion, sand transportation at inlets and hydraulic dredging. Any reduction in river silt loads, because of river development, will be good for the bay fishery. Convenient dumping of hydraulic spoil in the bays with subsequent "recirculation" back into channels by waves and currents and out again by maintenance dredging has for many years been causing serious damage by "mudding up" the clarity of the bays.

Indiscriminate spoil disposal has caused loss of valuable habitat; in addition,

there are innumerable cases of seriously blocking or changing bay water circulation and water interchange. It appears this trend is increasing instead of being placed under more responsible control. Most channels cut in the bays benefit the fishery by improved circulation of the water, but the only control over placement of dredge spoils is in the interest of commercial navigation, not in the interest of preservation and enhancement of the bay fishery.

A recent announcement that Secretary of the Interior Udall and Secretary of the Army Resor had signed an agreement to safeguard the resources of navigable waters is heartening. The principal areas involved are inland waters and about 8 million acres of prime estuaries where salt and fresh water meet and where wildlife and marine life thrive.

Representatives of the Department of the Interior and the U. S. Army Corps of Engineers will seek an agreement before decisions are made by the Corps of Engineers whether to grant permits affecting navigable areas. Concerned Federal and State agencies and others interested will be informed when dredging and similar applications have been filed with the Corps.

The two Secretaries in their "Memorandum of Understanding" have agreed that there shall be full coordination and cooperation between their departments relating to the control of dredging, filling and excavation in the Nation's navigable waters, and the Corps, which is empowered to grant these permits, will coordinate their programs with the Department of Interior's fish and wildlife, recreation, and antipollution responsibilities. The two Federal departments will also coordinate with State conservation, resources and water pollution agencies. I feel this is a step in the proper direction.

Wave-suspended and current-transported silt from shell dredging and shell washing operations (along with floods and high salinities) have affected live oyster reefs. Dredging operations for commerce are necessary, vital and valuable. However, they may not be compatible with the overall economy unless they can be and are actually done without serious damage to the ecology of the bay fishery. Improvements in some of our activities would help these estuaries withstand the impact of inevitable changes in fresh water runoff and increased, but polluted, return flow.

A significant advance in the science of tidal hydraulics was reported recently in a publication by the Corps of Engineers. Chapter VII, "Dredging and Disposal Practices in Estuaries," emphasizes the basic consideration of locating spoil areas so that dredged material does not find its way back into navigation channels to contribute to excessive volumes of maintenance dredging. Of particular interest is the statement that the dredged material must be transported to a place where it will do no harm, either to the channel or to valuable beds of the fishery. Proper dredging and disposal practices to achieve this goal are described in detail. The same basic principles and practices should also be applied to any permitted shell dredging operation, including washing and spoil disposal.

It is suggested that hydraulic spoiling from channel and shell dredging could be designed to improve, instead of spoil, the bays and estuaries. For instance, selection of sand and shell spoil could be used to improve the fishery if properly planned and placed. Other spoil could be used to build up low areas subject to hurricane tides. The spoil that cannot be used to advantage should be dredged by proper equipment and disposed of where it will not be detrimental to the fishery.

Incidentally, the hopper dredge is now used extensively in lower Galveston

Bay with spoil disposal in the nearby Gulf. However, disposal is not far from the end of the jetties and sometimes the countercurrents west of the south jetty return some of the suspended silt to spoil Galveston East Beach and South Jetty fishing.

All of this, plus the diminishing fresh water in flow, increasing pollution loads, the threat of further choking of Gulf water inflow by hurricane protection works, and the rapidly rising demand for recreation, produces some wildly disturbed estuaries.

There is at present insufficient information on the biology of the bays, their hydrology, and quality and temperature conditions to predict with reasonable certainty the impact of continued discharges of urban and industrial wastes and land runoff, even assuming the possibility of control of these waste discharges at present levels, an assumption which does not appear to be realistic. Projections of anticipated return flows from potential urban and industrial growth indicate that by the year 2020, without remedial action, the recreational value of the bays, as well as the commercial fisheries, could be destroyed.

Thus a principal recommendation of the Plan is a broadly based study of the hydrologic and structural requirements for the continued use, development, and enjoyment of these waters. The study will be directed toward determining the characteristics of the bays, alternatives to permit maximum use of the water resources of the bays, and the economic relationship of the various uses which are made and will be made in the future of the bay system. It will be concerned with the hydrology of the bay systems and the possibilities of hydraulic or structural modification which might improve nursery and spawning grounds of the diverse marine life. The study will also include the consideration of land use adjoining the bays.

Pending completion of this study, the objective of the Plan is to insure sufficient inflow of fresh water to the bays to maintain present water quality conditions.

Early in the Board's planning, it was recognized that increased return flows and major modification of the flow of rivers could greatly affect the water quality in the bay system. Therefore, quality criteria for the bays and estuaries could not be predicted upon maintaining historic volumes of flow, thereby precluding upstream development of surface-water resources.

A report prepared for the Board, "Return Flows — Impact on Texas Bay System," provided the results of a study designed to collect available data and to describe the general ecology of the bays; develop a mode of waste water estimation and project return flows to each bay system. Within the availability of the data, estimates were prepared on both the physical exchange and biological degradation which may occur as the diluted waste waters are transported into the bays. Attention was also directed to the fresh water inflows necessary for each of the major bays and estuaries to preserve the existing fish and wildlife resources and the fresh water inflows necessary to prevent the development of nuisance conditions under present and anticipated conditions. The study indicated much additional data would be necessary for a more complete evaluation of each of Texas' bays.

The Board authorized and financed an additional study to determine the amount of fresh water needed annually in the six major bays to maintain them for recreation and fish spawning. This study developed the concept of balanced tidal inlets, and proposed that increased and improved distribution of Gulf water inflow into the estuaries could be a substitute for excessive

fresh water requirements. The report, "Water for Preservation of Bays and Estuaries," forecast the quantity of fresh water inflow that would be needed in the six bays and estuaries provided maximum use of Gulf water to minimize fresh water needs was assured. "Fresh water" could also include properly treated return flows to meet the peculiar requirements of each estuary.

It has been roughly computed that annual fresh water needs from the developed rivers for the bays and estuaries will amount to 2.45 million acre feet annually while the annual Gulf water needs through new tidal inlets will amount to 33.4 million acre feet. There is a solution which would permit reasonable river development as well as save the most valuable fisheries.

The Texas Water Plan proposes to use Gulf water as much as possible to minimize needs for reservoir fresh water releases in the preservation of the bay system. A preliminary proposed conveyance system, spanning 980 miles from Northeast Texas to South Texas, would provide 950,000 acre feet of fresh water for bays and estuaries other than the Galveston Bay system.

In addition, the Texas Water Quality Board has initiated a comprehensive study of the Galveston Bay system to which the Board allocated a fresh water inflow of 1.5 million acre feet annually. The Bay, with approximately 520 square miles of surface area, is the largest and most significant bay on the Texas coast, both economically and biologically. It has approximately 418,000 acres of water surface and an average depth of six feet. The Bay area provides nursery grounds for more than 80 percent of the poundage of fish products taken from the Gulf of Mexico adjacent to the Texas coast.

Within the immediate bay area, however, are the port of Houston, the Houston ship channel, a major urban-industrial complex, and a present metropolitan area population of approximately 1.4 million people. At our present level of knowledge, it is impossible to determine the optimum quality of fresh water inflow for maximum beneficial use of this Bay in the face of the pollutional load imposed upon it by adjacent and upstream development. Therefore, decisions regarding the required quantity and quality of fresh water inflow must be based on value judgments, assumptions and intuition.

Joining the State of Texas in the study of this important bay system is the Federal Water Pollution Control Administration. The study, costing at least \$2.5 million and taking some three years to complete, is expected to be the first step in further studies of the other bay systems along the Gulf Coast. Although the Galveston Bay study has been scheduled over a three-year period, this doesn't mean that action to correct ills found during the study will not be taken until the study is completed. Just the contrary, the study has been specifically tailored to provide corrective measures as soon as conclusions have been developed and made available.

As a further step to improve the Galveston Bay system, legislation was introduced this year in the Texas Senate to create the Galveston Bay Area Authority, a Texas version of the Emschergerossenschaft in the Ruhr Valley of Germany. The Authority, to be composed of five counties, was designed to be the water quality management vehicle for this important bay system.

The bill did not make the full legislative cycle because of the delay in its introduction. However, sponsors of the proposed Authority will introduce the bill at the next regular legislative session, in January 1969.

The Galveston Bay study is apparently caught in the wave of economy washing the congressional halls in Washington, D. C. Funds for the State's share of the study have been provided, but until the current federal economy

wave subsidies and decisions are forthcoming, the study can not proceed as rapidly as had been planned.

In order to provide for a continuing evaluation of the bays and estuaries, the Texas Water Quality Board must provide for the measurement and reporting of quantities of effluent entering these bodies of water. Continued coordinated operation and planning of data acquisition programs by the several State agencies will provide detailed information needed at the proper times for periodic evaluation of water quality of the bays and estuaries, and for necessary administrative determinations

To resolve some of the problems indicated by our studies, the Board advanced several proposals for the enhancement and preservation of the bay systems. We plan:

- (1) To reduce pollution by treatment of wastes, and to improve bay circulation and distribution of Gulf water interchange, thus assisting the bays in assimilation of municipal, industrial, and agricultural return flows.

- (2) To achieve the maximum benefits from minimum fresh water by designed and controlled releases to selected spawning and nursery grounds.

- (3) To give further consideration to the future of commercial oystering in San Antonio and Matagorda Bays.

- (4) To provide responsible control of hydraulic dredge spoils in order to protect corrective and improvement investments.

There are many complicated problems involved in changing our concepts into reality. To find solutions to these problems will require improved communication and closer liaison between many divisions of the scientific and engineering community—coastal and hydraulic engineers, marine scientists and fishery biologists, geologists, sanitary engineers, hydrologists, hydrographers, cartographers, waterway engineers and others. A large amount of money is needed merely to collect the necessary input data for the computer programs. There is a dearth of scientific information on these long neglected bays and estuaries that must be collected and put into usable form.

With six or seven tidal inlets in mind but not yet placed into final dynamic balance, the State should have a first class coastal engineering and tidal hydraulics laboratory qualified and equipped to make tidal inlet model studies, and to assist in collecting scientific data and putting it into usable form.

Equitable financing of this program of tidal inlets is complicated by the multiple uses, widespread benefits, and various responsibilities with respect to aspects of preservation, enhancement and damages to the estuaries.

I would include the following in the multiple uses of tidal inlets:

- (1) To serve as grounds for marine sport fishing.

- (2) To move marine life into and out of their properly protected nursery and spawning grounds.

- (3) To control salinities by increasing or reducing as the needs dictate.

- (4) To provide the necessary tidal flushing to move in new Gulf water, move out excess flood waters, and flush out undesirable levels of pollution.

To a variable degree for individual tidal inlets—each has its unique design, function and benefits — the widespread benefits include:

- (1) Improvement of recreation and sport fishing, thereby inviting more tourists with resulting benefits to related commerce.

- (2) Improvement of commercial fishery.

(3) Creation, preservation, or improvement of spawning and nursery grounds.

(4) Control of pollution.

(5) Provision of the estuary fresh water needs when and where needed to allow well-planned, long-term development of rivers in the Texas Water Plan.

Responsibilities and interests vary from local to State to National levels. Agencies and people involved include recreationists, sport and commercial fishermen, tourists, water developers, water quality and navigation interests, shell dredgers, wild fowl hunters, ecologists, and many, many others. The benefits and responsibilities are so diverse and complex that financing will have to be based on some general, simplified formula of State and Federal participation.

Perhaps the really difficult problem is to convince all the people of Texas that balanced tidal inlets can be built along the Texas coast to serve the entire State. The past record will be hard to overcome. I do not believe, however, that we will shortchange future generations of Texans by turning our bays into holding ponds for pollution. Instead, I believe we will leave them a legacy that will benefit all Texas and be a monument to the dedication and wisdom of those who passed this way before them.