

Chesapeake Bay Study

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Chesapeake Bay, one of the world's most productive estuaries is situated in a rapidly expanding industrial and urban complex. Its location makes it probably more vulnerable to the adverse effects of man's work than any other estuarine system in the world. Saving it from severe damage by man requires a sound management program based on a firm foundation of expanding estuarine technology. Recognizing this need, the U.S. Congress, in Section 312 of the River and Harbor Act of 1965, directed the Secretary of the Army, acting through the Chief of Engineers, to make a complete investigation and study of the Chesapeake Bay basin and, further, to construct, operate, and maintain in the State of Maryland a hydraulic model of the Chesapeake Bay with an associated technical center.

The Chesapeake Bay study is a comprehensive estuarine study. It is multidisciplinary in scope, encompassing the fields of engineering and the physical, biological, and social sciences. This complete study of water utilization and control, involving the largest estuary in the nation and its spectrum of complex problems, is expected to yield significant knowledge of the interactions among many of the physical, chemical, biological, political, and social phenomena of importance to the Chesapeake Bay and other estuarine areas. This study will improve the environmentalist's ability to estimate the impact of man's work on estuarine ecology, based on the methodology to determine the carrying capacity of these important resources. The model is an indispensable tool in a study of such magnitude and scope. We will need to put it to use as soon as feasible during the study to obtain answers to problems which cannot be resolved otherwise. The model, when completed, should rapidly improve progress in our study of the conflicting uses of the Bay as they affect the total environment. The study is scheduled for completion by December 1976.

The objectives of the Chesapeake Bay study can be divided into three broad categories. The first objective is to provide an understanding of the existing physical, chemical, biological, economic, and environmental conditions of the Bay. The study will serve as a focal point for all research and management programs of the various federal, state, and local agencies having an impact on Chesapeake Bay.

The second objective is to define the attainable standards for the water-land resources of the Bay which are required to meet the needs of the people. These standards will be formulated from the following criteria: economic efficiency, regional development, environmental quality, and the well being of the people. Most importantly, the standards set for each water resource activity must be made compatible with all other activities.

The third objective of the study will be to provide a water-land management program to be used by all Bay management organizations for development, enhancement, conservation, preservation, and restoration of the Bay's resources. The program would consist of guidelines, management strategies, and programs that may be needed to assure wise utilization of the Bay's resources. This final study product is not the last word to be said about Chesapeake Bay, but it is a changing guide that can be amended to change in concert with increased knowledge of both this remarkable biological engine and the dynamic societal need.

The study is being managed by the District Engineer, Baltimore, Maryland, whose staff is experienced in managing resource development studies of comparable magnitude to the Chesapeake Bay study. Comprehensive planning experience in many disciplines has been developed and strengthened over time by intense involvement in diverse studies and continuous professional association with other agencies—state, federal, and educational—involved in the social, economic, and technical aspects of natural resource conservation and development. Fortunately the great reservoir of

technical capability within the educational and research institutions, as well as from the state and federal agencies of the Chesapeake Bay region, is available in the pursuit of a study of this magnitude and scope.

The State of Maryland and the Commonwealth of Virginia support progressive state planning departments and water resource study and management departments that have been working on Bay problems for a long time. Agencies of the Federal Government that have been engaged in Chesapeake estuarine affairs include many of the component parts of the Department of Agriculture, the Department of Health, Education, and Welfare, the Department of the Interior, and the Environmental Protection Agency, in addition to the Corps of Engineers.

The Chesapeake Bay region is fortunately served by the Chesapeake Research Council, consisting of Virginia Institute of Marine Science (VIMS), and units of Johns Hopkins University and University of Maryland. The council is one of the most significant scientifically oriented groups operating in the Chesapeake Bay area. The Council's many years of vigorous research in the biological and physical aspects of estuarine studies have made the Chesapeake Bay region a worldwide center for estuarine studies. This group has been actively engaged in our study. The VIMS Director represents the Commonwealth of Virginia on the Advisory Group; the Directors of all three institutions serve on the study's Steering Committee. All three distinguished scientists have been involved from the beginning of the study.

The study is conceived, therefore, not only as a multidiscipline, but also as a multiagency effort—coordinated among federal and state agencies and educational institutions. In addition, participation from the public is considered vital to the practical achievement of the study's objectives, and such participation is a firm component of the study.

Extensive interagency coordination necessary to accomplish the objectives of the Act could best be achieved through an advisory group established early in the study. Such an advisory group was organized in September 1967 by General Frank Koisch, then Division Engineer of the North Atlantic Division, who invited the Governors of Maryland, Delaware, Pennsylvania, and Virginia, the President of the Board of Commissioners of the District of Columbia, and Secretaries at Federal Cabinet level to designate representatives to work at field level with the District Engineer, Baltimore, Maryland.

The study was divided into five general areas:

- (1) Economic projections
- (2) Flood control, navigation, erosion, and fisheries
- (3) Water quality and supply, waste treatment, and noxious weeds
- (4) Recreation
- (5) Fish and Wildlife.

A task group was organized to cover each of the areas. A sixth task group, the steering committee for liaison and basic research, was formed to coordinate the work of the others.

From the beginning, the job of planning for the Chesapeake Bay will be one of decision making. The major decision to be made early in the study is whether the study is to be only reactive in terms of future needs, or if it is to be active in terms of attempting to support a plan to mold the future. Concepts of regional development, economic efficiency, and environmental quality as related to the study will be reviewed continually.

The study's objective is to identify and make a complete investigation of the problems in the system and present a full analysis of alternatives for the systematic resolution of conflicts among all interests. The study will not just compile an extensive inventory of bay-related problems. The role of the Chesapeake Bay Advisory Group in this venture will be to make available to decision makers a thorough analysis of planning alternatives by experts in the various fields connected with the bay environment.

The task groups have thus far done their jobs well. Outlines of programs submitted for inclusion in the study plan reflect serious deliberation and a genuinely cooperative spirit. The study has already begun to pay dividends by stimulating an increasing awareness of other agency programs and problems.

While pursuing each part of the study, constant emphasis is placed on the fact that a tidal waterway of the size of the Chesapeake Bay has a complex and subtle character. The Bay's hidden character could mislead the inexperienced into undertaking expensive works that may not fulfill their purpose, or could cause unanticipated and damaging results.

Because of the complexity of the hydraulic regime of Chesapeake Bay, powerful methods of analysis are required. Mathematical modeling is an excellent tool. It is useful in predicting the gross effects of changes on the hydraulic regime of the estuary. This modeling includes predicting tide elevations, discharges, and average current velocities over a given cross section. Unfortunately, however, information of this character is not sufficient for fine-drawn ecologic

design or decision. However the capability of mathematical modeling is considerably expanded when used in conjunction with hydraulic modeling. On the other hand, practically all estuarine physical problems can be solved satisfactorily in a properly constructed and verified hydraulic model. A hydraulic model is least useful in assessing scour and shoaling, but here also it possesses a level of competence not available in other methods of analysis. Some phenomena, such as wind setup cannot, however, be predicted by hydraulic modeling.

The problems most encountered in the estuary appear to be problems of navigation improvement and pollution effects traceable to rapid increase in population and activities associated with urbanization. The hydraulic model will be extensively used in studies related to navigation. The problems that arise from channel improvement are many and challenging. Increasing both depth and width of channels poses the problem of disposal of spoil material. When deposited overside, spoil may return to the channel and add to maintenance problems and costs. The fraction that remains in suspension, causing turbidity, may displace biological processes. Increasing channel dimensions may permit saline water to penetrate farther upstream under fixed fresh water inflow conditions than had previously been possible. A larger channel, permitting heavier traffic of larger ships in the channel could cause increases in shoreline erosion as a function of waves characteristic to vessel speed, draft, and hull shape. Also protective works, breakwaters, training works, etc., unless designed in harmony with estuarine dynamics, could be embarrassingly destructive.

The above problems can be effectively studied through the use of the hydraulic model. The model will be used to determine changes in the current and tidal regime that can result from proposed new construction. The change is superimposed on the model, and compared to the existing regime. The model will help determine in advance the effect on the estuary that major changes in bottom geometry will have on the hydraulic regime including tide elevations and current velocities. More complete knowledge of the extent of salt water intrusion and the effect on magnitude and location of shoaling problems associated with new construction can also be derived through the use of the model.

Other equally complex and critical problems resulting from the effects of accelerating urbanization will be amenable to study by the hydraulic model. One will be the study of effects on the hydraulic regime of the modification of fresh water inflows including both inter- and intra-basin diversion on the tributary streams. The determination of the effects of tributary activities on the Bay environment are of considerable concern to oceanographers and marine biologists working on the Bay. Fresh water diversions of sufficient magnitude can alter the salinity regime of the headwaters of the Bay and affect the spawning opportunities of many species of fish. By altering the salinity regime fresh water diversion can also alter the hydraulic regime and affect the rates of flushing of embayments tributary to Chesapeake Bay.

The most potentially damaging aspect of man's utilization of Chesapeake Bay is the very great discharge of untreated or partially treated wastes into it. This is doubly compounded by discharging the wastes into a highly complex water body, the biological and hydraulic regime of which reacts to hydrologic conditions which develop in drainage basins far removed from the Bay proper.

Through the use of dye injections, hydraulic model studies will be useful in the determination of flushing characteristics of both the bay proper and its tributary embayments. Model studies will also help in locating outfalls where the least damage will be done. Further, where there is a distinct possibility of significant oil spills or of injection of particularly deleterious industrial radioactive wastes the model will be used to define the translocation of wastes through the Chesapeake Bay system, possibly in time to initiate actions which will reduce their damaging effects.

Use of the nation's water resources for the dissipation of waste heat is potentially as dangerous as the unrestricted discharge of the more obvious domestic and industrial wastes. The large generating capacity of contemplated thermal power plants is forcing public utilities operators to look to the estuaries to meet the increased demand for cooling waters.

Little is actually known about heat discharges. Available data indicate that an important aspect of this problem is the location of plants where they will do the least harm. Hydraulic model studies can assist in preselection of plant sites, the determination of change in the hydraulic regime caused by plant construction activities, and estimation of the temperature regime to be imposed on the estuary by heat loading. All of these considerations must precede ecologic impact studies.

The process of land filling and reclamation can cause significant changes in estuarine hydraulics, besides having the potential of being ecologically unsound. Drastically reducing the water area can alter the existing current regime and reduce the volume of the tidal prism, thus reducing the capacity of the area to assimilate waste and flush itself. Here again the hydraulic model will prove valuable in assessing the practicability and long-term effects of landfill operations.

The current systems, tide stages, and water quality factors of Chesapeake Bay are complex and highly variable over time and space. When the works of man are superimposed on a regime controlled by astronomic, meteorological, and hydrologic forces that are as yet incompletely defined, it is immediately evident that even the most geometrically uncomplicated estuary is a difficult water body to evaluate. These difficulties are compounded many times over by an estuarine system as complicated and as extensive as the Chesapeake Bay. The hydraulic model of the Chesapeake Bay will be of great assistance in designing a viable management scheme to guide us in determining the future of the Bay. The task will be both exacting and exciting.

A technical center is included in the planning of the hydraulic model facility at Matapeake. Presently plans for the technical center are of modest proportion. Its proximity to Washington and Baltimore, and to local educational institutions, as well as the availability of waterfront facilities make this an attractive location for increased future development of facilities for estuarine related research.