



Fall 1969

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Technology, Institutions**

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Recommended Citation

Louis M. Falkson, *Kneese and Bower, Managing Water Quality: Economics, Technology, Institutions*, 9 Nat. Resources J. 673 (1969).

Available at: <https://digitalrepository.unm.edu/nrj/vol9/iss4/11>

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MANAGING WATER QUALITY: *Economics, Technology, Institutions*

By

ALLEN V. KNEESE AND BLAIR T. BOWER

Baltimore: Johns Hopkins Press for Resources for the Future. 1968.

Pp. x, 328, \$8.95.

This book is a substantial revision and extension of Kneese's 1964 book, *The Economics of Regional Water Quality Management*, which in turn updated his 1962 monograph, *Water Pollution: Economic Aspects and Research Needs*. The economist's law of diminishing returns does not seem to hold in this case since each revision has been a significant improvement over its predecessor. Because of the increase in research in the water pollution field during the past few years, it is not surprising that this latest edition has so much new material.

The present volume elaborates on Kneese's earlier theme that market focus in a private economy fails to provide adequate water quality because individuals do not bear the full cost of their waste disposal decisions. Whereas the earlier works were concerned primarily with explaining the problem but were less specific in suggesting public policy measures to manage water quality (the basin-wide firm which would internalize all of the external effects of waste disposal was introduced as a pedagogical device but was not seriously proposed as a solution), the present volume is concerned with a solution.

The first part of the book explains the nature of the water quality problem and provides the reader with the necessary technical background on the scientific aspects of water pollution. These aspects include the nature of major wastes entering water, their effect on receiving waters and the resulting effect on users of water. The first part of the book also contains a rather exhaustive discussion of the technological options available for reducing waste generation and for handling wastes after generation. The following table, which appears on page 42, indicates the wide coverage of technological options for improving the quality of receiving waters:

METHODS FOR REDUCING WASTE DISCHARGES

Methods for reducing waste generation

1. Change in type of raw material inputs
2. Change in production process
3. Change in product outputs

4. In-plant recirculation of water

Methods for reducing wastes after generation

1. Materials recovery
2. By-product production
3. Waste treatment
4. Effluent reuse

METHODS FOR INCREASING OR MAKING BETTER USE OF ASSIMILATIVE CAPACITY

1. Addition of dilution water
2. Multiple outlets from reservoirs
3. Reaeration of streams
4. Reservoir mixing
5. Saltwater barriers
6. Effluent redistribution

The second part of the book relates the economic theory of resource allocation to waste disposal at individual points of discharge. In this part of the book the authors explain the concept of an external effect and discuss the offsite costs or damages which result from waste disposal decisions. Loss functions are introduced to relate these damages to the level of waste discharge. Therefore, the benefits from pollution control are measured by the reduction in these damages. The authors then demonstrate that an optimal water quality management system requires that the incremental reduction in damages equal the incremental cost of waste reduction at each discharge point. Such criteria can then be used to evaluate the efficiency of various water quality management schemes such as effluent standards and effluent charges. The trouble with this approach is that it is often impossible to quantify the damages from water pollution in terms of money. For this reason, the search for a true economic optimum must often be abandoned. As the authors explain, "since the level of water quality to be achieved in each of the nation's water courses cannot be directly established on economic grounds—because all of the relevant benefits from water quality improvement cannot be computed . . . it appears that some form of water course standards will be the mechanism used to establish water quality levels."

Therefore, the aim of water quality management is to achieve the specified stream standards at the lowest possible cost. This would appear to be a purely technological problem but the point of the book is that suitable institutional arrangements and administrative mechanisms must be worked out if predetermined stream standards are to be achieved at the lowest possible cost. In particular, the au-

thors contrast the traditional effluent standard approach with proposals for systems of effluent charges and subsidies which create an incentive for a waste discharger to reduce his waste load. The authors present a very strong theoretical case in favor of effluent charges over other regulatory controls but time and space do not permit this argument to be summarized in this review. One important point which they make from the standpoint of administrative feasibility is that less information is required on the part of the pollution control authorities to achieve a specified stream standard at minimum cost with effluent charges than with other forms of regulation of individual discharges. Two case studies, the Ohio River Basin and the Delaware estuary, are used to provide examples of the potential performance of effluent charges relative to other control systems. In both cases effluent charges perform better than the other systems for regulating individual waste discharges. In Part III the authors show that if there are economies of scale in waste treatment or in other operations, then regulation of individual waste discharges through a system of effluent charges may not be sufficient to achieve the least costly waste disposal system in a region. In that case collective action such as the operation of regional waste treatment facilities and low flow augmentation dams might be required. The appendix to Chapter 10, which is the only mathematical section in the book, derives the conditions for the optimal design and operation of such collective facilities. The rest of Part III examines three cases of regional water quality management: the Corps of Engineers study of the Potomac Basin which is contrasted with Robert Davis' study for R.F.F. of the same basin, the FWPCA's Comprehensive Water Quality Study of the Delaware Estuary, and an examination of the *Genossenschaften* or river associations in the Ruhr area of West Germany.

Part IV deals with the administrative or organizational aspects of water quality management. Case studies include the *Genossenschaften*, the French Basin Agencies, English River Authorities and the Delaware River Basin Commission.

The final part of the book makes some recommendations for the United States. In particular, the authors recommend the creation of water quality management agencies with both regulatory and operating authority. They also suggest that systems of effluent charges be implemented as a regulatory device. These conclusions are based upon the nature of the technological problem and the resulting economic problems which determine the form of the administrative organization necessary for efficient regional water quality management. The authors emphasize that the jurisdiction of a water quality

management agency in terms of both geography and scope of operations should be determined by the nature of the problem rather than by political ideology. Yet, the authors recognize that the strongest impediments to the implementation of their proposals are likely to be political. Therefore, they attempt to show that their proposals are not as radical as they might appear to be. For example, they argue that effluent charges are really not much different from sewer charges to industrial plants which are connected to municipal waste treatment plants. A major strength of this book is the way in which it integrates recent developments in the theory of resource allocation, and systems analysis models of water quality management with the institutional and organizational framework and the political setting in which the theory is to be implemented.

This book is recommended to anyone who is looking for an introduction to the subject of water quality management. It should be required reading for every expert on some aspect of water pollution who is involved in public policy-making or who wishes to round out his knowledge of the subject.

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