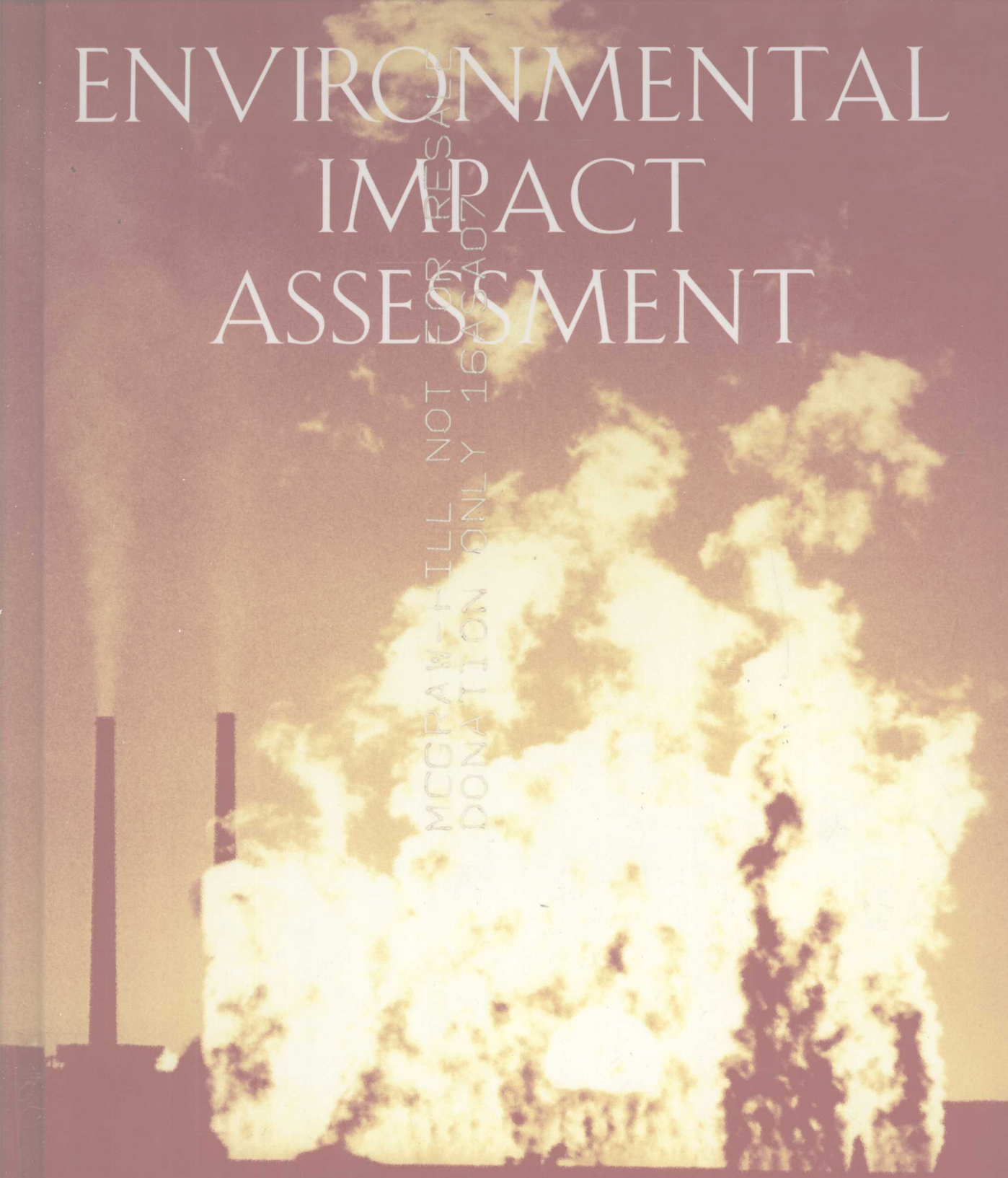
ENVIRONMENTAL IMPACT ASSESSMENT



Larry W. Canter

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LARRY W. CANTER, P.E., is the Sun Company Chair of Ground Water Hydrology, George Lynn Cross Research Professor, and Director, Environmental and Ground Water Institute, University of Oklahoma, Norman, Oklahoma. Dr. Canter received his Ph.D. in environmental health engineering from the University of Texas in 1967, M.S. in sanitary engineering from the University of Illinois in 1962, and B.E. in civil engineering from Vanderbilt University in 1961. Before joining the faculty of the University of Oklahoma in 1969, he was on the faculty of Tulane University and was a sanitary engineer in the U.S. Public Health Service. He served as Director of the School of Civil Engineering and Environmental Science at the University of Oklahoma from 1971 to 1979; and as Co-director of the National Center for Ground Water Research (a consortium of the University of Oklahma, Oklahoma State University, and Rice University) from 1979 to 1992.

Dr. Canter's research interests include environmental impact assessment (EIA) methodologies, ground water pollution source evaluation and ground water protection, soil and ground water remediation technologies, and market-based approaches for air-quality management and impact mitigation. Currently, he is conducting research on cumulative impact assessment and valuation methods for ground water resources. In 1982 he received the Outstanding Faculty Achievement in Research Award from the College of Engineering at the University of Oklahoma, and in 1983 the Regent's Award for Superior Accomplishment in Research.

Dr. Canter has written six books related to EIA; examples include *Environmental Impact Assessment* (McGraw-Hill, 1977, first edition), *Handbook of Variables for Environmental Impact Assessment* (Ann Arbor

Science, 1979), and *Environmental Impacts of Water Resources Projects* (Lewis Publishers, 1985). He is also the author or co-author of numerous book chapters, refereed papers, and research reports related to environmental impact studies. He has also written environmental assessments and environmental impact statements on projects such as power plants, gas pipelines and compressor stations, highways, wastewater treatment plants, industrial plants, and flood control dams.

Dr. Canter served on the U.S. Army Corps of Engineers Environmental Advisory Board from 1983 to 1989. Since 1979, he has taught several sessions annually of a one-week short course on EIA for the Corps. He has presented short courses, or served as advisor on EIA to several other governmental agencies in the United States and to institutions in Argentina, Brazil, Colombia, France, Germany, Greece, Hong Kong, Italy, Kuwait, Mexico, The Netherlands, Panama, the People's Republic of China, Peru, Saudi Arabia, Scotland, Sweden, Thailand, Turkey, and Venezuela. Finally, he is a member of the Consultative Expert Group on Environmental Impact Assessment of the United Nations Environment Program in Nairobi, Kenya.

PREFACE

The National Environmental Policy Act (NEPA) in the United States is considered to be the seminal legislation for the environmental impact assessment (EIA) process in the majority of some 100 countries that have adopted EIA legislation. EIA requirements of aid agencies and lending institutions are typically based on the principles included in the NEPA. The NEPA requires environmental impact considerations to be included in project planning along with traditional technical (engineering) and economic evaluations. The action-forcing mechanism in the NEPA is that environmental impact statements (EISs) must be prepared such that they describe the environmental consequences of major actions which significantly affect the quality of the human environment. Over 21,000 EISs have been prepared in the United States since the effective date of the NEPA (January 1, 1970), and even more will be prepared in the future. In addition, with the implementation of regulations developed in 1979 by the Council on Environmental Quality (CEQ), delineations have been made between EISs and environmental assessments (EAs). EAs are documents which are used to determine if EISs are necessary for proposed actions. It is estimated that 30,000 to 50,000 EAs are prepared on an annual basis in the United States.

This book represents an extensive revision of the 1977 edition by the same author. This author views the EIA process which culminates in either an EA or an EIS as consisting of six components: basics, impact identification, description of the affected environment, prediction and assessment of impacts, selection of proposed action, and documentation in accordance with extant guidelines. This textbook is organized according to these components. Chapters 1 and 2 encompass the basic requirements

and framework of the process, including reviews of legislative requirements and information on planning impact studies. Chapter 3 highlights matrices, networks, and simple and descriptive checklists for identifying potential impacts of proposed projects or activities. Chapters 4 and 5 are related to describing the affected environment, with the latter chapter focused on the use of environmental indices. Chapters 6 through 14 address the steps for impact prediction and assessment for the physical-chemical (air, surface-water, soil and groundwater, and noise), biological (nonhabitat and habitat), cultural (historic and/or archaeological and visual resources), and socioeconomic environments, in that order. Each of these substantive-area chapters is characterized by a stepwise approach for addressing the impacts of proposed projects or activities. Chapter 15 presents various impact-assessment methodologies that can be utilized in the evaluation of alternatives and the selection of proposed actions, with the emphasis being on decision-focused checklists related to multicriteria decision making. Chapter 16 describes public participation in the EIA process, particularly as related to the selection of a proposed action. Chapter 17 discusses pertinent considerations in writing Eqs or EISs, with the basic principles of technical writing summarized. Finally, Chapter 18 presents information related to the use of monitoring in the EIA process, including baseline and post-EIS monitoring. The focus is on the use of monitoring information in impact documentation and project management.

This book is intended for use in upper-division or graduate-level courses dealing with the EIA process. It can also be used as a reference book by practitioners. The orientation is primarily for science and engineering majors; however, individuals trained in other disciplines, such as planning and geography, can also utilize this text. Information is included that is relevant for both classroom presentations and illustrations of the practice of EIA.

It is noted that this book is primarily oriented to the EIA practice in the United States, with particular emphasis to the NEPA and relevant environmental laws. It can be utilized in other countries by appropriate substitution of information related to the EIA legislation and pertinent environmental laws within the application country.

It is noted that the EIA process should be considered a part of good planning practice; it should not be viewed as an "afterthought" implemented to satisfy environmental regulatory concerns following all key decisions related to the proposed project or activity. The optimum usage of the EIA process is from the establishment of the need for a project or activity and the delineation of potential alternatives to meet that need. The primary application of the EIA process to date has been focused on proposed projects/activities. There is a current emphasis on applying the EIA process to policies, plans, and programs, with these applications being referred to as "programmatic (or strategic) environmental assess-

ments." Representing a narrower focus, EIA process principles can also be applied in the context of the application process for permits related to water or air quality, or other waste-disposal or environmental-management activities. For example, an air-quality permit application includes an impact study related to the air-quality implications of the proposed project or activity.

This textbook has been assembled based upon continuing activities which the author has been engaged in since the initial edition in 1977. This process includes teaching university-level courses and short courses on EIA, the conduction of research related to specific methodologies or components of the process, and the actual preparation of EAs or EISs on proposed projects and activities.

This book is not meant to encompass every possible consideration in the EIA process. In fact, there are specific topics which are not addressed herein, including vibrational impacts and the potential environmental effects of electromagnetic radiation. This is a dynamic field and proper use of this textbook is as a reference for a point in time, with the understanding that it must be supplemented by additional information when technology becomes available. The following key observations are made as a result of the preparation of this book:

1. There is an enormous amount of information available for addressing different facets of the EIA process.
2. A scientific approach to impact identification, quantification, and evaluation is fundamental to the EIA process.
3. There are many tools and techniques which have been developed for usage in the EIA process, including scoping, checklists, matrices, qualitative and quantitative models, literature reviews, and decision-support systems.
4. While the EIA process can become technically complicated, it is recognized that scientifically based approaches which include simpler applications of available tools and techniques are appropriate.
5. Documentation is key to the EIA process; such documentation includes both written and verbal presentations and related environmental-monitoring data.

The author wishes to express his gratitude to a number of individuals who have participated directly or indirectly in the assemblage of information related to this book. These include former students such as Drs. Carlota Arquiaga, Sam Atkinson, Robert Knox, Mohammed Lahlou, Gary Miller, George Sammy, and Robert Westcott; and Geoff Canty, Stephen Kukoy, and Wylan Weems. These students have conducted research or participated in various EIA-related projects as part of their graduate work.

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The author has had the unique opportunity of becoming acquainted and collaborating with numerous international colleagues while participating in the EIA field. Of particular note are Professor Brian Clark and Sandra Ralston of CEMP at the University of Aberdeen and the opportunities that have been available to collaborate with them over many years in EIA training activities. Other colleagues include Drs. Gordon Beanlands, Maria Berrini, Virginio Bettini, Owen Harrop, Bindu Lohani, Barry Sadler, N. C. Thanh, and Peter Wathern; they have all contributed to this process. In addition, Ron Bisset, Robert Turnbull, and Henyk Weitzenfeld are also acknowledged.

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