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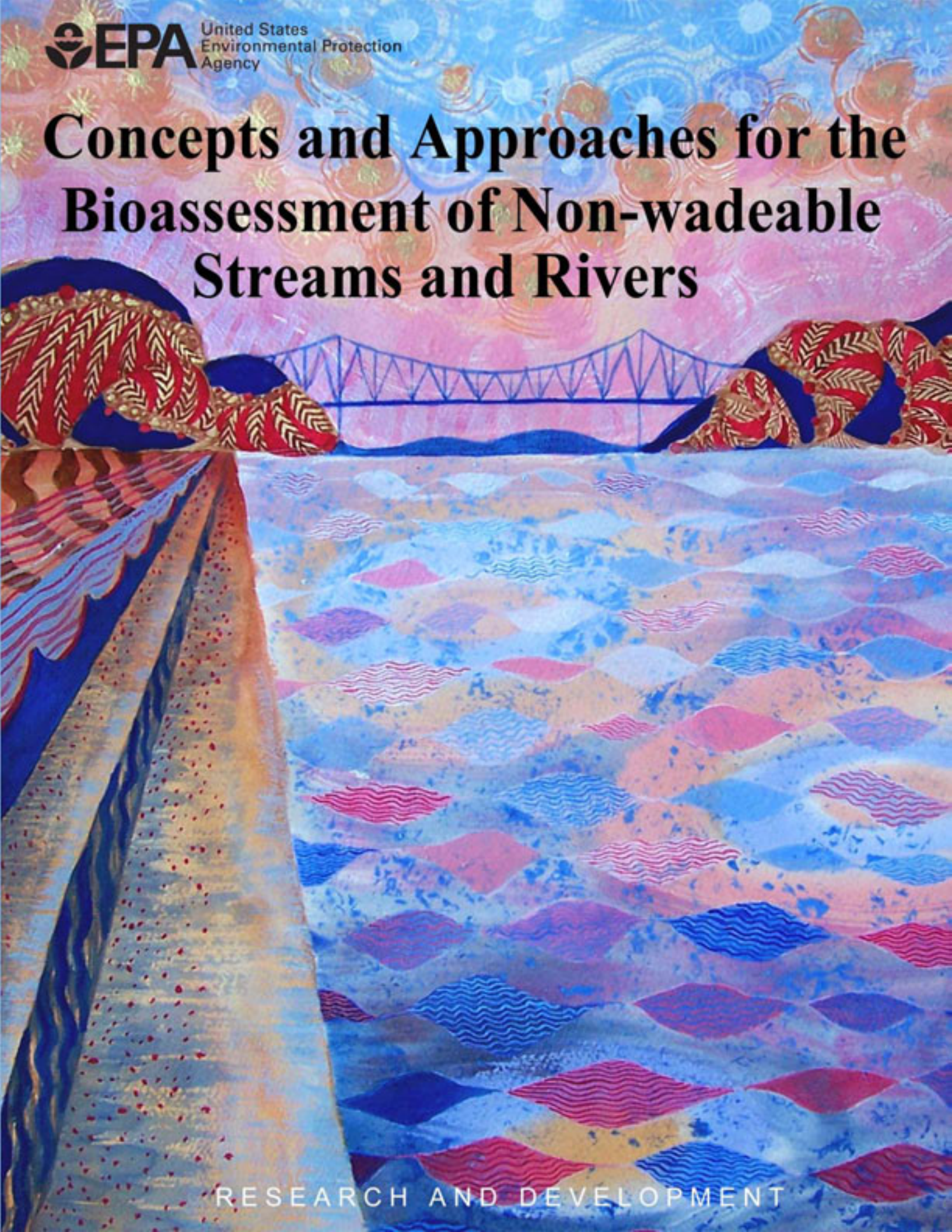
Concepts and Approaches for the Bioassessment of Non-wadeable Streams and Rivers



RESEARCH AND DEVELOPMENT

EPA/600/R-06/127
September 2006
www.epa.gov

Concepts and Approaches for the Bioassessment of Non-wadeable Streams and Rivers

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Notice

The U.S. Environmental Protection Agency through its Office of Research and Development funded and managed the research described here. It has been subjected to the Agency's peer and administrative review and approved for publication. The document was prepared at the EPA National Exposure Research Laboratory, Ecological Exposure Research Division, with support under contract 68-C-02-108 to Tetra Tech, Inc. Although this work was reviewed by EPA and approved for publication, it may not necessarily reflect official Agency policy. Mention of trade names and commercial products does not constitute endorsement or recommendation for use.

The correct citation for this document is:

Flotemersch, J. E., J. B. Stribling, and M. J. Paul. 2006. Concepts and Approaches for the Bioassessment of Non-wadeable Streams and Rivers. EPA 600-R-06-127. US Environmental Protection Agency, Cincinnati, Ohio.

This entire document can be downloaded from the website of the USEPA, Office of Research and Development, National Exposure Research Laboratory, Ecological Exposure Research Division:

http://www.epa.gov/eerd/rivers/

Foreword

"Downstream, that's where we are all headed. Out in the flow, we all feel it, sometimes turbulent, sometimes gentle flowing, but always moving…downstream."
Richard Russo
Empire Falls

Human history is replete with stories, songs, and pictures documenting the extraordinary importance and value of rivers to our lives. Almost every situation in life is reflected in rivers. Rivers are among the most animated of inanimate objects; among the liveliest of non-living natural things. Rivers offer us solace in times of trouble and instill awe in the power they can generate. They can provide a gentle place to rest, float, and think, but yet are persistent enough to erode even the hardest canyons the earth can muster.

Rivers touch all parts of the natural environment and nearly all aspects of human life and culture. They often act as centers of organization within landscapes. Their roles in providing natural resources such as fish and clean water are well known as are their roles in providing transportation, energy, diffusion of wastes and recreation (Naiman and Bilby 1998). However, as a consequence of this close relationship, the integrity of rivers is often challenged. Fish ecologist and essayist Peter Moyle has been quoted as saying "no matter how bad things are on land, you'll find that they're worse in nearby rivers." (Shepard 2001).

Sociocultural evolutionists have postulated that the United States has evolved from a pre-industrial society, to an industrial society, into what Daniel Bell (1973) coined a post-industrial society. Such societal changes are generally accompanied by changes in what society values. In the 1960's of the United States, this included an increased interest in the well-being and sustainability of our natural resources. ***This document is intended to provide support to those concerned with the well-being and sustainability of large rivers.***

There is a Chinese proverb that states *the mark of a successful man is that he has spent an entire day on the bank of a river without feeling guilty about it.* While this quote most likely speaks to the man's freedom from the need to earn money, the closest most of us will ever come is to enjoy earning our living on the banks of a river. This document represents an opportunity to do just that.

The US Environmental Protection Agency through its Office of Research and Development (Cincinnati, OH) and Regional Methods Initiative funded much of the research described herein and subsequent production of this document. The US Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, DC provided additional funding for document production. Tetra Tech, Inc. provided primary technical support. Much appreciation is extended to the extensive list of reviewers who provided thoughtful and detailed critique of earlier drafts, and assisted our efforts to push the document toward scientific peer review standards. Any shortcomings, however, remain the responsibility of the authors.

Preface

In 1998, the National Exposure Research Laboratory (NERL) of the US Environmental Protection Agency's Office of Research and Development (USEPA-ORD) received funding to develop standardized protocols for the bioassessment of large (i.e., non-wadeable) streams and rivers. The request came from scientists in USEPA's regional offices who recognized that states and tribes need these protocols (which we term Large River Bioassessment Protocols or LR-BP), to meet their monitoring and enforcement objectives. In response, we conducted several years of research and development to adapt existing or devise new protocols, specific to the ecological and logistical demands of these large, flowing systems. We systematically compared alternative approaches and documented their performance characteristics, collaborating extensively with regional, State and Tribal scientists to ensure that the protocols were both technically feasible and economically practical.

We originally conceived of this document as a compilation of these research results. At the request of the user community, however, we have expanded it to present a comprehensive technical framework for the bioassessment of non-wadeable streams and rivers. While presentation of the LR-BP remains our main focus, several other bioassessment approaches exist that vary in purpose and technical approach. Therefore, the document is structured to show the technical relationship of the LR-BP to other protocols, and to assist the user in the selection of those that best allow programmatic management objectives to be met. We realize that in some cases protocols will need to be modified; to support these cases, the document provides information to assist the reader in determining the performance characteristics of the modified protocol.

In several locations in the document, specific programs have been highlighted to provide examples of how program elements might be more fully developed. Highlights are not intended to indicate endorsement or recommendation of these programs, nor should they be used as a stand-alone reference for field application. For more information on field applications, please consult the cited materials on these programs:

> Kaufmann, P. R. 2000. Physical habitat characterization - non-wadeable rivers. Chapter 6 in J. M. Lazorchak, B. H. Hill, D. K. Averill, D. V. Peck, and D. J. Klemm (editors). Environmental monitoring and assessment program - surface waters: field operations and methods for measuring the ecological condition of non-wadeable rivers and streams. US Environmental Protection Agency, Cincinnati, OH. http://www.epa.gov/emap/html/pubs/docs/groupdocs/surfwatr/field/nonws1.html
>
> Moulton, S. R., II, J. G. Kennen, R. M. Goldstein, J. A. Hambrook. 2002. Revised protocols for sampling algal, invertebrate, and fish communities in the National Water-Quality Assessment program, U.S. Geological Survey Open-File Report 02-150. http://water.usgs.gov/nawqa/protocols/OFR02-150/index.html

Merritt, R. W., J. D. Allan, K. W. Cummins, K. J. Wessell, and J. G. O. Wilhelm. 2003. Qualitative biological and habitat survey protocols for Michigan's non-wadeable rivers. Submitted to the Michigan Department of Environmental Quality, Lansing, MI.

Ohio River Valley Water Sanitation Commission (ORSANCO). http://www.orsanco.org

For the most recent field operations material from the US Environmental Protection Agency's, Environmental Monitoring and Assessment Program, please consult:

Angradi, T. R. (editor). 2006. Environmental Monitoring and Assessment Program: Great River Ecosystems, Field Operations Manual. EPA/620/R-06/002. U.S. Environmental Protection Agency, Washington, D.C. http://www.epa.gov/emap/greatriver/fom.html

Peck, D. V., D. K. Averill, A. T. Herlihy, R. M. Hughes, P. R. Kaufmann, D. J. Klemm, J. M. Lazorchak, F. H. McCormick, S. A. Peterson, M. R. Cappaert, T. Magee, and P. A. Monaco. In press. Environmental Monitoring and Assessment Program - Surface Waters Western Pilot Study: Field Operations Manual for Non-Wadeable Rivers and Streams. EPA 620/R-0?/xxx. US Environmental Protection Agency, Washington, DC.

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Acronyms

ALU	Aquatic Life Use
USACE	US Army Corps of Engineers
ATtiLA	Analytical Tools Interface for Landscape Assessments
BCG	Biological Condition Gradient
BMP	Best Management Practice
BOD	Biological Oxygen Demand
BPJ	Best Professional Judgment
CAFO	Confined Animal Feeding Operation
CDG	Catchment Disturbance Gradient
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CSO	Combined Sewer Overflows
CWA	Clean Water Act
DEQ	Department of Environmental Quality
DQO	Data Quality Objectives
EMAP	Environmental Monitoring and Assessment Program
EPT	Ephemeroptera, Plecoptera, Trichoptera
FWPCA	Federal Water Pollution Control Act
GIS	Geographic Information Systems
GLEI	Great Lakes Environmental Indicators
HDG	Human Disturbance Gradient
HUC	Hydrologic Unit Code
IBI	Index of Biological/Biotic Integrity
ICI	Invertebrate Community Index
IDEQ	Idaho Department of Environmental Quality
ITFM	Intergovernmental Task Force on Monitoring Water Quality
LDM	Linear Discriminant Model
LR-BP	Large River Bioassessment Protocol
LWD	Large Woody Debris
MDCB	Methods and Data Comparability Board
MQO	Measurement Quality Objectives
NAWQA	National Water-Quality Assessment Program

NLCD	National Land Cover Database (NLCD)
NPDES	National Pollutant Discharge Elimination System
NWHI	Non-Wadeable Habitat Index
NWQMC	National Water Quality Monitoring Council
OHEPA	Ohio Environmental Protection Agency
ORSANCO	Ohio River Valley Water Sanitation Commission
ONRW	Outstanding Natural Resource Waters
PBMS	Performance Based Methods Systems
POTW	Publicly-Owned Treatment Works
QHEI	Qualitative Habitat Evaluation Index
RBP	Rapid Bioassessment Protocols
RIVPACS	River Invertebrate Prediction and Classification System
TALU	Tiered Aquatic Life Use
TMDL	Total Maximum Daily Load
SCI	Stream Condition Index
STP	Sewage Treatment Plants
UAA	Use Attainability Analyses
USEPA	United States Environmental Protection Agency
WLAs	Waste Load Allocations
WQS	Water Quality Standards
WWTP	Wastewater Treatment Plant