

# PREFACE

## CONTENTS

<b>Section</b>	<b>Page</b>
	<b>P-</b>
1.0 ACKNOWLEDGEMENTS.....	1
2.0 PURPOSE OF THE <i>MANUAL</i> .....	5
3.0 LIST OF ABBREVIATIONS .....	7



## 1.0 ACKNOWLEDGEMENTS

The Urban Drainage and Flood Control District (District) wishes to acknowledge and thank all individuals and organizations that contributed to development and publication of the 2001 update of the *Urban Storm Drainage Criteria Manual, Volumes 1 and 2 (Manual)*. The lists of individuals and organizations that follow are our best effort to acknowledge all of the organizations and individuals that were directly involved in the *Manual's* preparation and the members of the Stormwater Manual Advisory Committee (SMAC) who provided technical guidance and review. We apologize to anyone that may have contributed to the development of this *Manual* and has not been listed here.

### **URBAN DRAINAGE AND FLOOD CONTROL DISTRICT**

Ben R. Urbonas, P.E.	Editor-in-chief and coauthor of the <i>Manual</i>
L. Scott Tucker, P.E.	<i>Manual</i> Update Management Committee
William G. DeGroot, P.E.	<i>Manual</i> Update Management Committee
David W. Lloyd, P.E.	<i>Manual</i> Update Management Committee
Mark R. Hunter, P.E.	<i>Manual</i> Update Management Committee
Ken A. MacKenzie, EIT	AutoCAD™ details and design spreadsheets
David Bennetts	<i>Manual</i> review and coauthor of example
David L. Mallory, P.E.	<i>Manual</i> review
Cindy L. Thrush, P.E.	<i>Manual</i> review and coauthor of example

### **WRIGHT WATER ENGINEERS, INC.**

Jonathan E. Jones, P.E.	Project manager, editor and coauthor
Kenneth R. Wright, P.E.	Principal-in-charge and coauthor
Peter D. Waugh, P.E.	Project engineer and Coauthor
James C.Y. Guo, Ph.D., P.E.	Design spreadsheets and examples
T. Andrew Earles, Ph.D.	Coauthor
Jonathan M. Kelly, P.E.	Coauthor
Ernest L. Pemberton, P.E.	Coauthor
Robert J. Houghtalen, Ph.D., P.E.	Coauthor
Larry A. Roesner, Ph.D., P.E.	Reviewer
Neil Grigg, Ph.D., P.E.	Reviewer
Terri L. Ohlson	Administrative and document production lead
Jane K. Clary	Technical editor
Patricia A. Pinson	Document production and research
Kurt A. Loptien	AutoCAD™ details
Chris K. Brown	Graphics

**STORMWATER MANUAL ADVISORY COMMITTEE**

**Working Group**

Dennis Arbogast	BRW, Inc.
Tom Browning	Colorado Water Conservation Board
Frank Casteleneto	City of Thornton
O. Robert Deeds	City of Littleton
William DeGroot	Urban Drainage and Flood Control District
Mike Galuzzi	McLaughlin Water Engineers, Ltd.
Mike Glade	Coors Brewing Company
Mark Hunter	Urban Drainage and Flood Control District
David Lloyd	Urban Drainage and Flood Control District
William McCormick	City of Aurora Engineering
Barry Moore	EMK Consultants, Inc.
Besharah Najjar/Louis DeGrave	Adams County Engineering
Tom Nelson	Denver Wastewater Management
Mary Powell	ERO Resources Corporation
Terry Rogers	City of Lakewood
Jeanie Rossillon	Jefferson County Highways & Transportation
Scott Tucker	Urban Drainage and Flood Control District
Ben Urbonas	Urban Drainage and Flood Control District
Richard Weed	Carroll & Lange, Inc.
Bill Wenk	Wenk Associates

**Milestones Group**

Russell Applehans	City of Broomfield
Sheri Atencio-Church	Town of Morrison
Sheila Beissel	City of Westminster
Terry Benton	City of Brighton
Alma Bergman	Town of Bow Mar
Vern Berry	U.S. EPA Region VIII
Dick Brandt	Town of Parker
Stan Brown	City of Castle Rock
Tim Carey	U.S. Army Corps of Engineers
John Cotton	City of Lone Tree
Kathy Dolan	Colorado Water Quality Control Division
Pat Dougherty	City of Arvada

Timothy Gelston	City of Cherry Hills Village
Kevin Gingery	City of Loveland
Robert Geobel	City of Wheat Ridge
Bob Harberg	City of Boulder
Dan Hartman	City of Golden
David Henderson	City of Englewood
David Hollingsworth	Longmont Department of Public Works
Peter Johnson	City of Lafayette
Scott Leiker	Colorado Department of Transportation
Duane Lubben	City of Lakeside
Dennis Maroney	City of Pueblo Public Works
Larry Matel	Boulder County
Kevin McBride	City of Fort Collins
Wendi Palmer	Town of Erie
Tom Phare	City of Louisville
Leela Rajasekar	Colorado Department of Transportation
Lanae Raymond	Arapahoe County Engineering
Brad Robenstein	Douglas County
Ken Ross	City of Englewood
Ken Sampley	City of Colorado Springs
John Sheldon	City of Greenwood Village
Bruce Shipley	City of Northglenn
Daren Sterling	City of Commerce City
Steve Sullivan	Town of Foxfield
Stan Szabelak	City of Federal Heights
Bob Taylor	City of Glendale
Amy Turney	Denver Water Department
Betty Van Harte	City of Mountain View
Stan Walters	City of Sheridan
Bruce Williams	City of Superior
Jim Worley	Cherry Creek Basin Water Quality Authority

**CONTRIBUTING FIRMS**

- Aquatic and Wetland Company\*
- BRW, Inc.\*
- Camp Dresser & McKee, Inc.\*

Carroll & Lange, Inc.

Design Concepts, Inc.\*

EDAW\*

Matrix Design Group, Inc.\*

McLaughlin Water Engineers, Ltd.\*

Merrick and Company

Muller Engineering Company, Inc.\*

Sellards & Grigg, Inc.\*

Taggart Engineering Associates, Inc.\*

The Norris Dullea Company\*

The Restoration Group, Inc.

Urban Edges, Inc.

Water & Waste Engineering, Inc.\*

Wenk Associates\*

---

\* Coauthor of design example(s).

**CONTRIBUTORS TO ORIGINAL (1969) VERSION OF THE *MANUAL***

All residents of the Denver metropolitan area have benefited significantly from the pioneering vision of those who were responsible for the original (1969) version of the *Manual*, including D. Earl Jones, Jr., P.E., Dr. Jack Schaeffer, Dr. Gilbert White and Kenneth R. Wright, P.E. (lead author). The vast majority of the policies, principles, and criteria in the 1969 *Manual* are found in this updated (2001) version—a true testament to the wisdom of these leaders.

## 2.0 PURPOSE OF THE *MANUAL*

Volumes 1 and 2 of the *Manual* provide guidance to local jurisdictions, developers, contractors, and industrial and commercial operations in selecting, designing, constructing, and maintaining stormwater drainage and flood control facilities. This *Manual* covers a variety of topics, including the following:

Chapter 1	Drainage Policy
Chapter 2	Drainage Law
Chapter 3	Planning
Chapter 4	Rainfall
Chapter 5	Runoff
Chapter 6	Streets/Inlets/Storm Sewers
Chapter 7	Major Drainage
Chapter 8	Hydraulic Structures
Chapter 9	Culverts
Chapter 10	Storage
Chapter 11	Flood Proofing
Chapter 12	Revegetation
Chapter 13	Design Examples

A reference section is provided for each chapter, and additional materials and insight on the topics presented in the *Manual* may be found by studying the papers and documents listed at the end of each chapter. Additionally, on the CD version of this *Manual*, a series of design spreadsheets and software are provided including:

### **Software**

CUHP 2000  
 HY8 (FHWA HY8 Culvert Analysis Microcomputer Program)  
 UD CHANNEL  
 UD POND (Hydropond)  
 UD INLET

### **Spreadsheets**

UD-Channels  
 UD-Culvert  
 UD-Detention  
 UD-Inlet  
 UD-Raincurve

UD SEWER

UD-Rainzone

UDSWM

UD-Rational

These software programs may also be obtained through the District's Web site ([www.udfcd.org](http://www.udfcd.org), under DOWNLOADS), which should be checked for periodic updates.

The District's Maintenance Eligibility Guidelines as of June 2001 are also provided on the CD version of this *Manual*. Again, the District's Web site should also be checked for periodic updates.

**The *Manual* provides the minimum criteria and standards recommended by the District. Providing for facilities that go beyond the minimum is encouraged. In addition, there may be other requirements by local, state and federal agencies that may have to be met in addition to the minimum criteria provided herein.**

### 3.0 LIST OF ABBREVIATIONS

#### **Commonly Used Abbreviations**

ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
BCD	Baffle chute drop
BFE	Base flood elevation
BMP	Best management practice
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CGIA	Colorado Governmental Immunity Act
CMP	Corrugated metal pipe
CRS	Colorado Revised Statutes
CUHP	Colorado Urban Hydrograph Procedure
CWA	Clean Water Act
CWCB	Colorado Water Conservation Board
DCIA	Directly connected impervious area
DRCOG	Denver Regional Council of Governments
EGL	Energy grade line
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FHAD	Flood Hazard Area Delineation
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study

FPE	Flood protection elevation
GSB	Grouted sloping boulder
HGL	Hydraulic grade line
HUD	U.S. Department of Housing and Urban Development
H:V	Horizontal to vertical ratio of a slope
ICC	Increased cost of compliance
LID	Low impact development
MDCIA	Minimized directly connected impervious area
NAVD	North American Vertical Datum
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
PMP	Probable maximum precipitation
RCP	Reinforced concrete pipe
SBA	Small Business Administration
SEO	Colorado State Engineer's Office
SFHA	Special Flood Hazard Area
SFIP	Standard Flood Insurance Policy
SWMM	Stormwater Management Model
TABOR	Taxpayers Bill of Rights
TWE	Tailwater elevation
UDSWM	Urban Drainage Stormwater Management Model

USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WEF	Water Environment Federation
VHB	Vertical hard basin
WQCV	Water quality capture volume

### **Commonly Used Units**

cfs	cubic feet per second
cfs/ft	cubic feet per second per foot
ft	foot
ft <sup>2</sup>	square feet
ft/ft	foot per foot
ft/sec	feet per second
ft/sec <sup>2</sup>	feet per second squared
hr	hour
in	inch
in/hr	inches per hour
in/hr/ac	inches per hour per acre
lbs	pounds
lbs/cy	pounds per cubic yard
lbs/ft <sup>2</sup>	pounds per square foot
lbs/ft <sup>3</sup>	pounds per cubic foot
lbs PLS/acre	pounds pure live seed per acre
min	minute
psi	pounds per square inch
psf	pounds per square foot