



Trails Design and Management Handbook



OPEN SPACE AND TRAILS PROGRAM
PITKIN COUNTY, COLORADO



OPEN SPACE AND TRAILS PROGRAM
PITKIN COUNTY, COLORADO

Trails Design and Management Handbook

Revision 1.1
JANUARY 20, 1994

PREPARED BY



NATURESHAPE

Troy Scott Parker
8285 Kincross Drive
Boulder, Colorado 80301
tsparker@natureshape.com
303-530-1785

Foreword

AT ITS BEST, A TRAIL is a unique extension of its site. Much more than merely a connection between two points, a trail can create a safe and sustainable corridor through the site which brings visitors into the site's natural features. A trail can be subtly integrated into its site such that it feels like it belongs there — complementing the site with its presence — and in the process making us feel as if we, too, belong there. And the best trails provide a rich combination of landscape, visual and sensory experiences, intellectual discoveries, and emotions and feelings that continually makes them enjoyable to use, time and time again.

Trails such as this usually don't just happen. They are designed to be sustainable, to bring visitors in contact with the site — to be enjoyable to use. This specification is intended as a first step in creating such trails as part of a state-of-the-art trail system especially suited to Pitkin County's environment, residents, and visitors.

GOALS OF THIS SPECIFICATION

This specification is designed to help produce unique trails that are uniquely suited to their sites and users. At the same time, it is intended to provide a recognizable design consistency between trails and to eliminate the need to start from scratch with every trail.

As outlined in these pages, the trail design process begins with a

thorough examination intended to reveal the dozens of interrelated aspects that together shape trail planning and management. Extensive guidelines are given for relating these aspects in a balance that resolves the many natural and man-made forces operating on a given trail.

This specification then gives planning and construction details for various common trail features, along with design and aesthetic issues for creating a quality trail experience. Designs for trail surfaces and drainage are based on the best of both time-proven methods and on state-of-the-art methods. Designs for structures, signs, and trailside features are largely based on the mining and ranching heritage of Pitkin County, as well as on the character of the mountain and valley landscape.

Realizing that all sites and trails are unique, this specification often gives a great deal of flexibility in trail design. Nearly all trail features can be built in more than one way, and guidelines are given for choosing between various methods. To further create flexibility, the word "should" is used much more often than "shall." Except where the physical stability of the trail or the safety of users would be compromised, the spirit of this specification should be considered more important than the letter. This specification can and should be extended as needed.

All parts of the trail system are designed to be cost-effective with low maintenance. Quality design

and construction, combined with frequent inspections and light maintenance, are intended to prevent major problems.

THE CHARACTER OF THE TRAILS

Trails designed through this specification are intended to have a sturdy grounded feel — to feel as if they are integral parts of their neighborhoods and sites. Simple lines, heavy square timbers, practical unembellished designs, and the use of natural materials such as native stone, wood, crushed stone, and linseed oil wood treatment are intended to evoke an unpretentious solid western feeling for both residents and visitors. The desired feeling is a simple elegance resulting from the blending of

effective design, solid practicality, native materials, and careful craftsmanship. Natural materials are favored over high-tech or man-made materials, but the latest in technology is employed where appropriate. Site preservation, restoration, and revegetation efforts are designed to integrate trails with both sites and neighborhoods.

It is hoped that combining these design guidelines with respect for natural resource values will produce a trail system that becomes an important and eagerly-supported part of life in Pitkin County. May you be able to enjoy many years of good trail experiences.

– Troy Scott Parker
June 1993

Acknowledgements

THE AUTHOR GRATEFULLY acknowledges the many individuals and organizations that assisted with this specification. First, thanks to Mark Fuller and the Pitkin County Open Space and Trails Program for having the foresight to commission this work. The basic concept for developing this specification came largely from Park City, Utah, in their *Trails Master Plan Update* dated April 1992, from the City of Aspen, Colorado, *Pedestrian Walkway and Bikeway System*, and from other communities whose trail systems and planning work helped to show the way.

Editing assistance was gratefully provided by Hugh Duffy of the Rivers, Trails, and Conservation Assistance Program of the National Park Service, Rocky Mountain Division. Stuart Macdonald, Colorado State Trails Coordinator, was very helpful in providing supporting materials and literature. Ron Henderson of Henderson Concrete, Montrose, Colorado, generously provided detailed information on concrete construc-

tion, as did Dennis Erickson from the City of Montrose, Colorado, Parks and Recreation Department. Details for Type 1 boardwalk decks are derived from designs by Design Workshop, Denver, that were used in the Winter Park Outdoor Center constructed by Volunteers for Outdoor Colorado (VOC). VOC also deserves thanks for providing a proving ground for crusher fines construction techniques and for making available the Winter Park Outdoor Center design.

The author would also like to thank Christopher Alexander and his colleagues for the ideas expressed in *The Timeless Way of Building* and *A Pattern Language* — many of the concepts from their work are included in this specification in ways far too numerous to mention.

And, last but not least, thanks to all the unnamed trail planners, contractors, builders, and others whose cumulative trail work all around the country forms the basis for much of this specification.

THE PITKIN COUNTY OPEN SPACE AND TRAILS PROGRAM

ON NOVEMBER 4, 1990, Pitkin County voters approved a citizen initiative establishing the Pitkin County Open Space and Trails Board of Trustees and authorizing the program to raise funds through a property tax and bonds. Resolution 90-93 of the Board of County Commissioners enabled the Open Space and Trails Board to “establish acquisition priorities and recommend management guidelines and other relevant policies and procedures to guide the expenditure of open space and trails funds.” (See Appendix B for the complete Open Space and Trails Board Objectives and Policies statement).

The mission of the Open Space and Trails Program is to

“acquire, preserve, maintain and manage open space for multiple purposes including, but not limited to, recreational, wildlife, agricultural, access, and scenic purposes and to acquire, preserve, develop, manage and maintain trails for similar purposes.”

Likewise, trails dedicated to the County as a result of private land development approvals are subject to the same mission statement. Trails are an important and valued form of land use in Pitkin County.

This *Trails Design and Management Planning Handbook* has been adopted by the Open Space and Trails Board and the Pitkin County Commissioners as an amendment to the County Trails Plan previ-

ously adopted in 1991 by Resolution 91-___, replacing the “Trail Guidelines” section and expanding on the evaluation procedure and approval process described in Section II of that Plan. These guidelines are consistent with County Land Use Code and other relevant regulations.

TRAIL DESIGN AND MANAGEMENT PLANNING

The County has adopted guiding policies regarding trails acquisition, stewardship, and advocacy which this Trail Design and Management Handbook is designed to implement. Building and operating a quality trail system requires the appropriate, site-specific application of functional, cost-effective, low impact, and easily maintained design concepts. Every trail segment presents different physical conditions and management challenges. The implementation of design and management standards must be flexible enough to adapt to those changing needs while still achieving the overall trail objectives of the County. The County’s trail stewardship practices always seek to preserve and enhance the ecological, scenic, agricultural, and cultural resources acquired through the Open Space and Trails Program or through land use approvals.

Trail design and management planning are intended to help ensure that those stewardship obligations are met through a thorough planning requirement

which is consistently applied to each individual trail project. The trail design process seeks continuity and consistent quality, but avoids the strict application of rigid design specifications where creative adaptations of the design guidelines can achieve a superior outcome. The management planning process seeks to identify, in advance, the appropriate uses for a trail, its maintenance needs, the likely management issues, and the management resources that can be applied.

Meeting the County's Trails Goals

The 1991 Pitkin County Trails Plan, Section IV, states that the County's goal is

“to provide a pedestrian, bicycling, equestrian, fishing, and nordic trails system which is properly maintained and accessible; which provides a good trails experience to residents and visitors alike in all seasons; and which functions as an important part of the transportation system, or which provides an opportunity for the public to recreate in wilderness settings.”

Good trail design and appropriate management are both essential to the achievement of that goal. Further, the County recognizes that not all existing trails meet the County's goal. This document is designed to guide the County and the public through a thorough examination of good trail design and appropriate management in the course of proposing, approving, building, or upgrading the County's trail system.

THE COMPLETE TRAIL APPROVAL PROCESS

The development of the County trail system will occur within the context of the County's land use regulations as described in this Handbook. In order to provide the information necessary to prepare a trail proposal, this Handbook is laid out as follows:

Section 1

Trail Design Process and Guidelines

This section presents general design process and guidelines for all trail types. The design of trails should follow this process and meet these guidelines as much as possible.

Section 2

Multiple Use Hard Surface Trail Specifications

Section 3

Crusher Fines Trail Specifications

Together, Sections 2 and 3 present the County's design guidelines for these trail types and for attendant trail system improvements. The goals, design concepts, recommended specifications, and anticipated maintenance needs for each trail type are presented and explained. Where a feature or concept applies to both trail types, it is presented in Section 2.

Section 4

Trail Proposal and Evaluation Process

This describes the step-by-step progression of a trail proposal toward County approval, whether it originates from the private sector, from the Open Space and Trails Program, or from another entity. The requirements for proposals for new trails (and for evaluation of existing trails) are also given here.

Reference

Supporting reference materials are included in Appendix C.

CONTENTS

TABLE OF CONTENTS

FOREWORD v

ACKNOWLEDGEMENTS vii

INTRODUCTION

The Pitkin County Open Space and Trails Program ix

Trail Design and Management Planning ix
The Complete Trail Approval Process x

SECTION 1

Trail Design Process and Guidelines 1-1

A. Why Have A Trail Here? 1-1

B.

Trail Purpose 1-2

C. Users, Usage Levels, and User Conflicts 1-2

D. Trail Type and Width 1-3

E. General Trail Corridor Guidelines 1-5

F. Working With Property Lines and Densely Developed Areas 1-7

G. Trail Corridor Selection Process 1-8

H. General Trail and Corridor Design 1-8

I. Relationship Between Trail and Site 1-10

J. Safety and Human Aspects 1-12

K. Construction 1-13

L. Maintenance 1-13

M. Stewardship 1-14

Details of Working with Property Lines and Densely Developed Areas 1-16

Best Case — A Long-Established Boundary 1-16

Second Best Case — A Route Between Two Very Different Land Uses 1-16

Middle Case — A Highway Right-of-Way 1-16

Second-to-Worst Case — Hemmed-in Development Trail 1-18

Worst Case — Between Highway and Development 1-18

SECTION 2

Hard Surface Multiple Use Trail Specifications 2-1

Usage and Site Parameters 2-2

Usage Parameters 2-2

Site Parameters 2-2

User Types 2-2

Corridor Selection and Width 2-4

Minimum Final and Construction Easement Widths 2-5

Grades, Sightlines, Curve Radii, and Vertical Clearance 2-6

Grades 2-6

Sightlines 2-6

Curve Radii 2-6

Vertical Clearance 2-6

Hazard Zones and Side Clearance 2-7

Hazard Zones 2-7

Side Clearance 2-7

Constricted Trail Width 2-9

Use of Curves in Alignment 2-10

Use of Grades in Alignment 2-11

Switchbacks 2-12

Intersections Between Multiple Use Hard Surface Paths 2-13

Hard Surface Materials: Concrete and Asphalt 2-14

Concrete versus Asphalt 2-14

Concrete and Asphalt Maintenance 2-16

Concrete Path Specifications 2-18

Objectives for Concrete Path Surfaces 2-18

Initial Grade Preparation 2-18

Subgrade Preparation 2-18

Specifications for Concrete Work† 2-19

Asphalt Path Specifications 2-23

Initial Grade Preparation 2-23

Subgrade Classification 2-23

Selecting the Appropriate Specification 2-23

General Specifications for All Asphalt Work 2-24

Hard Surface Trail Cross Sections 2-26

Minimal Cross Slopes 2-26

Cut/Fill Construction 2-27

Grading Specifications 2-27

Full Bench Construction 2-29

Superelevation 2-31

Path Drainage 2-32

Underpasses 2-35

Grade Crossings 2-40

Grade Crossing Details 2-42

Trailheads 2-44

Design Guidelines for All Trailheads 2-44

Trailheads With Parking 2-50

Summary of Design Guidelines 2-50

Trailheads Without Parking 2-52

Grade Crossings 2-53

Trailheads for Other Agencies 2-54

Bridges 2-55

Bridges Versus Other Options 2-55

Aesthetic Issues in Selecting a Bridge Design 2-55

Bridge Types 2-55

Selecting a Bridge Type 2-55

Bridge Alignment 2-56

Bridge Abutments and Piers 2-56

Standard Wooden Bridge 2-59

General Planning Sequence 2-59

General Materials and Construction Notes 2-59

Standard Steel Truss Bridges 2-64

Manufacturers 2-64

Bridge Design Factors 2-64

Signs 2-66

General Sign Standards 2-66

Regulatory Signs on Trails 2-67

Regulatory Signs For Vehicles at Trailheads and on Roads 2-67

Informational Signs on Trails and at Trailheads 2-67

Regulatory Signs on Trails 2-69

Regulatory Signs for Motorized Vehicles on Roads and at Trailheads 2-73

Informational Signs on Trails and at Trailheads 2-74

Retaining Walls 2-83

Stone Retaining Walls 2-83

Timber Retaining Walls 2-85

Other Types of Retaining Walls 2-86

Railings 2-87

Fences 2-91

Boundary Fencing 2-91

Circulation Control 2-92

Bulletin Boards 2-93

Adjacent Soft Surface Trails 2-94

Boardwalk 2-99

Design Features for Boardwalks 2-101

Materials Specification 2-103

Boardwalk Maintenance 2-104

Type 1 Boardwalk 2-105

Type 2 Boardwalk 2-112

Site Preservation, Restoration, and Revegetation 2-114

- Site Preservation 2-114
- Site Restoration 2-115
- Site Revegetation 2-116
- Trail Closure 2-117

Features for the Physically Challenged 2-118

Equestrian Trails 2-120

- General 2-120
- Equestrian trail maintenance 2-120
- Criteria for determining equestrian access 2-120

Nordic Trails 2-121

- General 2-121
- Factors in Determining Nordic Use of Regular Trails 2-121

Hard Surface Multiple Use Trail Maintenance 2-122

- Inspection, Maintenance, and Preventive Maintenance Checklist 2-122
- Hard Surface Trail Inspection and Maintenance Schedule 2-124
 - First Year 2-124
 - Each Subsequent Year 2-124
 - Notes on Maintenance Beyond the Second Year 2-125

SECTION 3

Crusher Fines Surface Trail Specifications 3-1

Usage and Site Parameters 3-2

- Usage Parameters 3-2
- Site Parameters 3-2
- User Types 3-2

Crusher Fines Characteristics 3-4

Specification and Testing of Crusher Fines 3-6

- Specification 3-6
- Testing 3-6
- Cost and Estimation of Quantity 3-7

Overview of Crusher Fines Trail Types 3-8

- Type 1: Bike Path 3-8
- Type 2: Primarily Pedestrian With Bicycle and/or Wheelchair Access 3-9
- Type 3: Pedestrian Only 3-9

Crusher Fines Type 1: Bike Paths 3-10

- Grades 3-10
- Drainage Features 3-11
- Curves 3-12
- Sightlines 3-12
- Hazard Zones and Side Clearance 3-12
- Vertical Clearance 3-12
- Superelevation 3-13

Crusher Fines Type 2: Primarily Pedestrian With Bicycle and/or Wheelchair Access 3-14

- Grades 3-14
- Drainage Features 3-15
- Curves 3-16
- Sightlines 3-16
- Hazard Zones 3-16
- Side Clearance 3-17
- Vertical Clearance 3-17

Crusher Fines Type 3: Pedestrian Only 3-18

- Grades and Alignment 3-18
- Drainage Features 3-19
- Curves and Sightlines 3-20
- Hazard Zones 3-20
- Side Clearance 3-21
- Vertical Clearance 3-21

Crusher Fines Trail Cross Sections 3-22

- Minimal Cross Slope 3-22
- Cut/Fill Construction 3-24
 - Grading Specifications 3-24
- Full Bench Construction 3-26

Crusher Fines Trail Drainage 3-27

- Outslope 3-27
- Crowning 3-28
- Superelevation 3-28
- Side Swales and Culverts 3-29
- Grade Breaks 3-30
- Drainage Dips 3-32
- Swale Crossings 3-35
- Causeway and Channelization 3-37
- Stepping Stones 3-38
- Steps 3-39

Crusher Fines Path Construction Methods 3-43

- Initial Grade Preparation 3-43
- Selecting a Trail Construction Method 3-43
- Installation of the Crusher Fines Surface 3-44

Crusher Fines Trails for the Physically Challenged 3-49

- Accessibility and Application 3-49

Crusher Fines Trail Maintenance 3-51

- Inspection, Maintenance, and Preventive Maintenance Checklist 3-51
- Crusher Fines Trail Inspection and Maintenance Schedule 3-53
 - First Year 3-53
 - Each Subsequent Year 3-53
 - Notes on Maintenance Beyond the Second Year 3-54

SECTION 4

Trail Proposal and Evaluation Process 4-1

- How to Propose a New Trail 4-1
- A. General Information 4-2
- B. Mapping 4-2
- C. Trail Corridor Guidelines 4-3
- D. Existing Trail Conditions Audit 4-3
- E. General Trail and Corridor Design 4-3
- F. Relationship Between Trail and Site 4-4
- G. Safety and Human Aspects 4-4
- H. Construction 4-5
- I. Maintenance 4-5
- J. Stewardship 4-5

APPENDIX A

Adoption of General Objectives and Policies A-1

APPENDIX B

Open Space and Trails General Objectives and Policies A-3

- Introduction A-3
- Acquisitions A-3
- Stewardship A-4
- Advocacy A-5
- Performance and Efficiency A-5
- Public Support A-6

APPENDIX C

References A-7