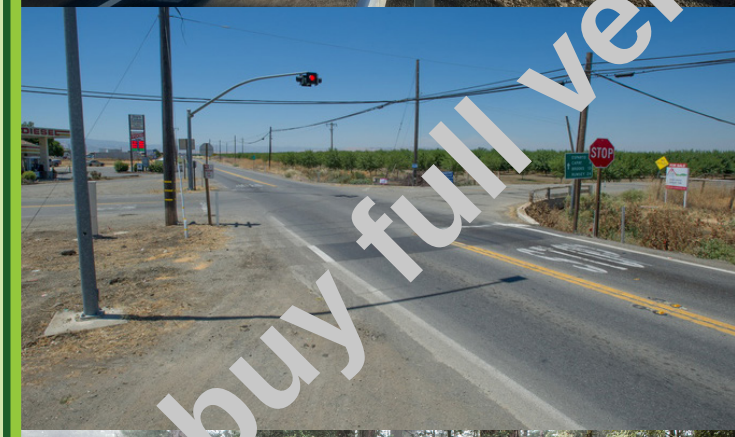
SECOND EDITION

Guidelines for Geometric Design of Low-Volume Roads

2019

American Association of State Highway and Transportation Officials
AASHTO



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Publication Code: VLVLR-2
ISBN: 978-1-56051-726-9

Cover photos courtesy of Caltrans Photography.

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TABLE OF CONTENTS

Chapter 5

LIST OF FIGURES

LIST OF TABLES

FOREWORD

As road designers, engineers strive to provide for the needs of highway users while maintaining the integrity of the environment. Unique combinations of design requirements that are often conflicting result in unique solutions to design problems. The geometric design of low-volume roads presents a unique challenge because the low traffic volumes and reduced frequency of crashes make designs normally applied on higher volume roads less cost effective. The guidance supplied by this document, *Geometric Design Guidelines for Low-Volume Roads*, addresses the unique needs of such roads and the geometric designs appropriate to meet those needs. These guidelines may be used in lieu of the guidance in *A Policy on Geometric Design of Highways and Streets*, commonly known as the Green Book (**5**).

The first edition of these guidelines, published by AASHTO in 2001, which addressed roads with design volumes of 400 vehicles per day or less, was the result of a research and development process initiated by AASHTO in 1996. These guidelines were initially developed through two projects of the National Cooperative Highway Research Program (NCHRP), which is jointly sponsored by AASHTO and the Federal Highway Administration. After completion of the NCHRP research, these guidelines went through the normal AASHTO review process. During the development process of the first edition, representatives of other interested organizations such as the National Association of County Engineers, the American Society of Civil Engineers, the U.S. Forest Service, the American Public Works Association, and the National League of Cities participated in the review of the guidelines.

This second edition is the result of a new research and development process initiated by AASHTO in 2013 through the NCHRP program. After completion of the NCHRP research, these guidelines went through the normal AASHTO review and balloting process. AASHTO appreciates the advice of the U.S. Forest Service in the development of this edition of the guidelines. The scope of these new guidelines includes local and minor collector roads with traffic volumes of 2,000 vehicles per day or less.

Design values are presented in this document in both U.S. customary and metric units and were developed independently within each system. The relationship between the U.S. customary and metric values is neither an exact (soft) conversion nor a completely rationalized (hard) conversion. The U.S. Customary values are those that would have been used had the policy been presented exclusively in U.S. Customary units; the metric values are those that would have been used if the policy had been presented exclusively in metric units. Therefore, the user is advised to work entirely in one system and not attempt to convert directly between the two.

The fact that new design values are presented herein does not imply that existing streets and highways are unsafe, nor does it mandate the initiation of improvement projects. *A Policy on Geometric Design of Highways and Streets* (**5**) states that specific site investigations and crash history analysis often indicate that the existing design features are performing in a satisfactory manner. The cost of full reconstruction for these facilities, particularly where major realignment

is not needed, will often not be justified. This is especially true for low-volume roads, which experience substantially fewer crashes than roads with design volumes greater than 2,000 vehicles per day. These guidelines recommend an approach to geometric design for low-volume roads, including both new construction and projects on existing roads, that is based on research concerning the safety cost-effectiveness of geometric elements. For projects on existing roads, reviews of site-specific conditions also are a key element of the design guidance presented here.

These guidelines address issues for which appropriate geometric design guidance for low-volume roads differs from the policies normally applied to higher volume roads. For any geometric design issues not addressed by these guidelines, design professionals should consult *A Policy on Geometric Design of Highways and Streets* (**5**).

The intent of these guidelines is to assist the designer by referencing a recommended range of values for critical dimensions. It is not intended to be a detailed design manual that could supersede the need for the application of sound principles by the knowledgeable design professional. Flexibility in application of these guidelines is encouraged so that independent designs tailored to particular situations can be developed.

Roads, vehicles, drivers, and nonmotorized users (pedestrians and bicyclists) are all integral parts of transportation safety and efficiency. While this document primarily addresses geometric design of roads, a properly equipped and maintained vehicle and reasonable and prudent performance by the user are also needed for safe and efficient operation of the transportation facility.

PREFACE

This Guideline was developed as part of the continuing work of the AASHTO Council on Highways and Streets. The Council, then titled the Committee on Planning and Design Policies, was established in 1937 to formulate and recommend highway engineering policies. This Council has developed *A Policy on Geometric Design of Rural Highways*, 1954 and 1965 editions; *A Policy on Arterial Highways in Urban Areas*, 1957; *A Policy on Design of Urban Highways and Arterial Streets*, 1973; *Geometric Design Standards for Highways Other Than Freeways*, 1969; *A Policy on Geometric Design of Highways and Streets*, 1984, 1990, 1994, 2001, 2004, and 2011; *A Policy on Design Standards—Interstate System*, 1956, 1967, 1988, 1991, 2005, and 2016; and a number of other AASHTO policy and guide"publications.

An AASHTO publication is typically developed through the following steps: (1) The Council selects subjects and broad outlines of material to be covered. (2) The appropriate subcommittee and its task forces, in this case the Committee on Design and the Technical Committee on Geometric Design, assemble and analyze relevant data and prepare a tentative draft. Working meetings are held and revised drafts are prepared, as necessary, and reviewed by the Committee until agreement is reached. Standards and policies must be adopted by a two-thirds vote by the Member Departments before publication. During the developmental process, comments are sought and considered from all the states, the Federal Highway Administration, and representatives of the American Public Works Association, the National Association of County Engineers, the National League of Cities, and other interested parties.

This Guideline was first published by AASHTO in 2001 for application to very low-volume local roads and some collector roads with design average daily traffic volumes of 400 vehicles per day or less. This second edition has been updated for application to all low-volume local and minor collector roads with design average daily traffic volumes of 2,000 vehicles per day or less.

1 Introduction

1.1 INTRODUCTION

This document presents geometric design guidelines for low-volume roads. The purpose of the guidelines is to help highway designers in selecting appropriate geometric designs for roads with low traffic volumes. The design guidelines presented here may be used on low-volume local and minor collector roads in lieu of the applicable policies presented in the AASHTO publication, *A Policy on Geometric Design of Highways and Streets* (**5**), commonly known as the Green Book.

This chapter defines low-volume roads, describes the scope of the design guidelines, explains the relationship of the guidelines to other AASHTO policies, and presents the organization of the remainder of this document.

1.2 DEFINITION OF LOW-VOLUME ROADS

The guidelines presented in this document are applicable to low-volume roads. Low-volume roads are defined as follows:

A *low-volume road* is a road that is functionally classified as a local or minor collector road and has a design average daily traffic volume of 2,000 vehicles per day or less.

The preceding statement indicates that the functional classification of a road is a key element of the definition of a low-volume road in these guidelines. A *local road* is a road whose primary function is to provide access to residences, farms, businesses, or other abutting property, rather than to serve through traffic. Although some through traffic may occasionally use a local road, through traffic service is not its primary purpose. The term local road is used here to refer to the functional classification of the road and is not intended to imply that the road is necessarily under the jurisdiction of a local or municipal unit of government. *Rural minor collector roads* generally serve travel of intracounty rather than statewide importance and constitute those routes on which predominant travel distances are shorter than major collector and arterial routes. *Urban minor collector streets* provide both land access service within residential neighborhoods and commercial and industrial areas and connections to streets of higher functional classification. Administrative arrangements for operation of the highway system vary widely and, in different parts of the United States, roads that are functionally classified as local and minor collector roads may be under Federal, state, or local control.

More than 80 percent of the roads in the United States have traffic volumes of 2,000 vehicles per day or less. The low-volume local and minor collector roads, defined above, to which the guidelines presented in this document are applicable, should include most of this extensive road mileage. Little of this road mileage would be classified as arterials. In some states, portions of the state-numbered route system meet the definition of low-volume minor collector roads and can be addressed with these guidelines.

In addition to serving motor vehicle traffic, low-volume roads also serve varying numbers of pedestrians and bicyclists. The needs of pedestrians and bicyclists should be considered in the design of each project. Some low-volume roads may serve pedestrians and bicyclists only rarely, but other low-volume roads, particularly in urban areas, serve pedestrians or bicyclists, or both, in sufficient numbers that specific pedestrian or bicycle facilities, or both, are needed.

1.3 SCOPE OF GUIDELINES

The guidelines presented in this document are intended for application in the design of low-volume roads, as defined above, including application in new construction of low-volume roads and in the improvement of existing low-volume roads. The scope of the guidelines includes roads in both rural and urban areas.

These design guidelines enable designers for projects on low-volume roads to apply design criteria that are less restrictive than those generally used on *higher volume roads*. Where the term *higher volume roads* is used in this document, this refers to roads with design volumes of more than 2,000 vehicles per day, which are outside the scope of these guidelines. The risk assessment on which the guidelines are based shows that these less restrictive design criteria can be applied on low-volume roads without substantial effects on crash frequency and severity. The guidelines discourage widening of lanes and shoulders, changes in horizontal and vertical alignment, and roadside improvements except in situations where such improvements are likely to provide substantial reductions in crash frequency or severity. Thus, projects designed in accordance with these guidelines are less likely to negatively impact the environment, roadway and roadside aesthetics, existing development, historic and archeological sites, and endangered species. In reviewing the geometric design for sections of existing roadway, designers should strive for consistency of design between that particular section and its adjoining roadway sections. The potential effects of future development that may affect the traffic volume, vehicle mix, and presence of pedestrians or bicyclists on the roadway should also be considered.

These design guidelines are intended to encourage rational safety management practices on low-volume roads. Expenditures for highway improvements are discouraged at sites where such improvements are likely to have little effect on crash frequency or severity, but are strongly encouraged at sites where crash patterns exist that can be corrected by a roadway or roadside improvement. Designers are provided substantial flexibility to retain the existing roadway and roadside design, where that existing design is performing well, but are also provided flexibility to recommend improved designs, even designs that exceed the guidelines presented here, where needed to correct documented crash patterns or meet other agency goals.

The scope of these guidelines includes geometric design for new construction and for improvement of existing roads. Geometric design criteria for new construction apply to construction of a new road where none existed before. Projects on existing roads may involve reconstruction, resurfacing, rehabilitation, restoration, and other types of improvements.

These guidelines are limited in scope to geometric design issues and do not address the application of traffic control devices on low-volume roads. For traffic control device guidance, see the *Manual on Uniform Traffic Control Devices* (**8**).

1.4 RELATIONSHIP TO OTHER AASHTO POLICIES

The design guidelines presented in this document may be applied to low-volume roads in lieu of the applicable policies of the AASHTO Green Book (**5**) and the AASHTO *Roadside Design Guide* (**3**). For projects on local roads and streets, these design guidelines may be applied in place of Chapter 5 (Local Roads and Streets) of the AASHTO Green Book (**5**) to local roads that serve design volumes of 2,000 vehicles per day or less. For projects on minor collector roads and streets that serve design volumes of 2,000 vehicles per day or less, these design guidelines may be applied in place of the applicable policies in Chapter 6 (Collector Roads and Streets) of the AASHTO Green Book (**5**). The design guidelines presented here address design issues for which an explicit risk assessment has been performed. For design issues that are not addressed in these guidelines, the designer should consult the applicable sections of the AASHTO Green Book (**5**) and the AASHTO *Roadside Design Guide* (**3**). Design of facilities for nonmotorized users is addressed in the AASHTO *Guide for the Planning, Design, and Operation of Pedestrian Facilities* (**1**) and the AASHTO *Guide for the Development of Bicycle Facilities* (**4**).