TRENCHLESS RENEWAL
of Culverts and Storm Sewers

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Trenchless Renewal of Culverts and Storm Sewers

Prepared by
the Pipeline Infrastructure Committee of
the Pipeline Division of
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Edited by
Lynn Osborn

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PREFACE

The Task Force for Trenchless Renewal of Culverts and Storm Sewers of the ASCE Committee on Pipeline Infrastructure (PINS) of the ASCE Pipeline Division is proud to present this Manual of Practice. The manual describes culvert and storm sewer renewal technologies used by engineers and transportation professionals in renewing culverts and drainage structures under roads, railroads, airport runways, streets, and similar structures. For the purpose of this manual, culverts and storm sewers are defined as having a diameter or equivalent diameter range of 12 in. (305 mm) to 144 in. (3,658 mm), with at least one open end. The manual covers topics such as safety, cleaning and inspection, condition assessment and evaluation, description of trenchless renewal methods, and life-cycle considerations. The PINS Committee, under the leadership of Larry Catalano, P.E., is responsible for the efforts leading to this publication. The committee thanks contributors, task force members, and blue ribbon reviewers, whose names follow, for their support, time, and effort. The efforts of Dr. Mohammad Najafi, Director of the Center for Underground Infrastructure Research and Education (CUIRE) at the University of Texas at Arlington, and Diego Calderón, a UTA–CUIRE research assistant, are greatly appreciated.

Lynn Osborn, Chair
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INTRODUCTION

Many good textbooks and manuals describe renewal techniques for sanitary sewers, and many of the described techniques are suitable for the renewal of culverts and storm sewers. However, the literature is lacking in detailed guidance for those in search of information on renewal techniques specifically for culverts and storm sewers. The purpose of this book is to provide a resource for engineers, transportation and government agencies, consultants, and others who are not familiar with or need a refresher course on culvert or storm sewer renewal.

The ASCE task committee that prepared this manual spent a lot of time discussing what the book should include. Although it is about the renewal of culverts and storm sewers, the more the task committee discussed the content, the more we realized that the book should focus on culverts and not storm sewers. Many storm sewer systems consist of pipes, manholes, and structures with pipe sizes in the 8–96-in. (203.2–2,438.4-mm) range. Renewal of storm sewer systems in these pipe ranges is similar to sanitary sewer renewal. Several manuals, textbooks, and publications currently available discuss these renewal techniques. A listing of these related documents can be found at the end of this chapter. Therefore, the task committee agreed that this book need not cover this territory again. In general, this manual covers culverts crossing under transportation systems, such as roads, highways, airports, railroads, and canals.

However, there are some gray areas. For example, what about a culvert passing under a school or playground? Renewal of this culvert would be the same as if this culvert passed under a highway if there is at least one open end for that culvert. As a result of lengthy discussions, the task committee decided to limit the scope of this book as described in the following section.

1.1 SCOPE OF THE MANUAL

The task committee developed a mission statement: "The purpose of this manual of practice is to address trenchless renewal of culverts and storm sewers with a diameter or equivalent diameter range between 12 in. (305 mm) and 144 in. (3,658 mm). The culverts and storm sewers must have at least one open end with any renewal proceeding from the open end to the first structure from the open end."

This scope allows the inclusion of storm sewers that have one open entrance or open discharge. Any renewal processes described are applicable from the open end to the first structure. From the first structure on, the storm sewer system becomes an enclosed system, and renewal processes for enclosed systems are defined in other publications, such as Najafi (2005).

Some of the renewal processes described in this book have technical envelopes that go outside of this scope. For example, some spray-on techniques have no practical upper size limit. For some processes, it does not matter whether the culvert or storm sewer is open-ended. For all products and processes, technical envelopes and capabilities are covered in detail in Chapter 5 on renewal methods.

The most common types of culvert materials are concrete, plastic, and metal. Concrete culverts are available in almost any size, including the size range specified in the scope of this book, and many shapes. Typical shapes are round, rectangular, arch, and elliptical. Plastic culverts are round and are generally manufactured from high-density polyethylene (HDPE) or polyvinyl chloride (PVC) and are available in either smooth or profile wall designs. Metal culverts are also available in many sizes and shapes, including round, box, arch, and elliptical. Although the most common type is corrugated steel (metal) pipe, corrugated aluminum pipe can also be used.

Practically any material available for pipes or conduits has been used for culvert construction. However, for a broad range of applications and for a large number of culverts, concrete, plastic, and steel continue to be the most widely used and cost-effective. Culverts consist of an entrance, a barrel, and an outlet. For noncircular shapes, size is described by culvert rise and span. For circular culverts, size is expressed as culvert diameter. Figure 1-1 illustrates components of a culvert.

The major subjects discussed in this book are the following:

safety,
cleaning and inspection,
evaluation and condition assessment,
renewal methods,