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Inland Navigation: Locks, Dams, and Channels

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Inland Navigation: Locks, Dams, and Channels

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Abstract::
Inland Navigation: Locks, Dams, and Channels (ASCE Manuals and Reports on Engineering Practice No. 94) was prepared by a task committee of the Waterways Committee, which is part of the Waterways, Ports, Coastal, and Ocean Division. The Manual provides information on planning, design, construction, and operation of the US waterways used by barge traffic. Most of the information comes from design criteria and more than 100 years of experience of the US Army Corps of Engineers. The Corps has built more than 220 lock and dam projects on US waterways and maintains more than 25,000 miles of inland navigation channels. This Manual also includes an inventory of the Corps Lock and Dam projects and six case histories.

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Chapter 1
INTRODUCTION

1.1 PURPOSE

This Manual provides guidance in the planning, design, construction, and operation of shallow-draft waterways, factors that should be considered, and solutions that have been successful in avoiding or eliminating undesirable conditions. This Manual is intended to provide an overview of the design process and operation of waterways used by barge traffic. The numerous references in the Bibliography provide more detail and examples that can be used to supplement this Manual. This Manual consolidates information from many sources with much of the information coming from recent manuals published by the US Army Corps of Engineers.

1.2 HISTORICAL DEVELOPMENT

Inland waterways have always provided a link for agricultural products and manufactured goods from the interior to the coastal ports of the world. The evolution of inland waterways in the United States started with canoes and rafts then continued with riverboats either rowed or pulled in natural rivers. The next major phase was steam-powered vessels on natural rivers. This mode of navigation was limited by excessive currents during floods, limited depths during low flow seasons, and shifting channels.

These limitations on navigation prompted the development of controlled waterways with locks and dams. The dams created reservoirs with predictable channel depths and the locks provided a means to allow safe passage from one pool to the next. Early locks had small chambers and low lifts. Filling and emptying were normally end-filling methods. These locks were filled by a slight opening of the upstream gate or opening small valves in the upstream gate. An example of this type of filling system is the Willamette

Falls Lock shown in Figure 1-1. The lock consists of 4 chambers. Each chamber is 40 ft wide and 210 ft long. Each lift is about 10 ft for a total lift of 41 ft. The maximum vessel draft is 6 ft. These locks were built in 1872 and are still operated by the US Army Corps of Engineers for both commercial and recreation traffic. More details and photos of this lock are provided in Chapter 20.

These early locks were replaced with large locks with higher lifts. An example of the newer locks is the John Day Lock on the Columbia River. This lock has a lift of 110 ft and the chamber is 86 ft wide and 669 ft long. Figure 1-2 shows the John Day Lock. At the present time the inland waterway system in the United States consists of 25,000 miles of inland waterways, over 220 navigation lock and dam sites, and lock lifts in excess of 100 ft. The largest locks in the US system are 1200 by 110 ft for barge traffic and 1350 by 80 ft for ship traffic. The US inland waterway system is shown in Figure 1-3.

1.3 BACKGROUND

Development or improvement of waterways for shallow-draft navigation involves the solution of many problems, particularly when the use of natural streams is involved. These problems are concerned with the factors that could adversely affect the safe and efficient movement of traffic, water quality, and environment. Unless these factors are considered and incorporated in the design of the project, hazardous conditions or delays could occur to such an extent that commercial traffic would not be economically competitive with other modes of transportation or the traffic potential of the waterway would not be fully developed. Development or improvement of waterways for navigation usually involves large expenditures for channel excavation, rectification, and stabilization; training structures; modification and construction of bridges; and in many cases, the construction of locks and dams. Since the modifications and structures are provided primarily for navigation, it is important that conditions resulting from these works be satisfactory and adequate for the traffic anticipated and provide a high degree of reliability.

1.4 SCOPE

This Manual provides an overview of the essential elements of an inland waterway navigation system. Due to the experience of the Task Committee, the main emphasis of this Manual is the design of navigation, locks, dams, and channels. Other subjects presented in less detail are environmental design, economic analysis, construction, operation, and maintenance. It is the hope of this Task Committee that these related subjects with less coverage could be developed into complementary manuals to provide an in-