CHAPTER 2

PRELIMINARY PLANNING AND LAYOUT

2-1. Justification. Justification for the development of a waterway for navigation is based on feasibility studies covering the amount and type of traffic that could be developed, commodities that would be moved on the waterway, effect on the environment and economic development of the region, and estimated cost of construction, maintenance, and operation. This should include a study of the region, centers of population, resources that would be developed, characteristics, potentials and history of the region, and cost of moving commodities by water compared with other modes of transportation.

2-2. Preliminary Planning. Initial planning would require the collection and evaluation of all pertinent data including special surveys needed to evaluate the probable short- and long-term effects on local environment and development of the waterway. The information should include topographic and hydrographic data, hydrologic and hydraulic data, geological information, soil characteristics and location of existing and proposed highways, railroads, bridges, and industrial complexes. This information would be required to determine routes to be followed, type of waterway that could be developed most economically, and estimated cost.

2-3. Evaluation of Existing Streams. The first step is to evaluate the existing river systems to determine their ability to accommodate navigation. The necessary studies are channel widths and depths at various seasons, sediment load, extent of bank erosion, flood magnitude and frequency, and environmental factors such as water quality and biologically important habitats.

2-4. Commodities to be Moved. The next step in designing a commercial waterway is to develop an estimate of the expected commodity shipments. These shipments will establish the requirements to be accommodated. Shipments can be broken down to commodities, season in which moved, return trip traffic, and needed barge type and size. Also needed are the trip time and tow sizes necessary to make the waterway route more economical than other modes of transportation.

2-5. Features Considered. This background information can now be applied to design of a waterway. The design procedure requires optimization of the following interrelated features:

a. Open river or canalization.

b. Channel size.

c. Tow size.

d. If canalized, size and number of locks.

2-6. Waterway Types. The type or types of waterways that could be developed will vary with local conditions. The types normally considered are open river, canalized streams with locks and dam, land-cut canals, or a combination of one or more of these types. Each type has its advantages and disadvantages which have to be considered.

2-7. Open River. The towing industry would prefer open-river navigation since it would eliminate delays normally encountered in passing through locks, but this is not practical on many streams because of their characteristics and local restraints. Many problems are associated with open-river navigation, and development and maintenance of this type of waterway usually involve some channel rectification, training and stabilization structures, maintenance dredging, and navigation aids. Changes in river stage and discharge produce changes in channel width and depth and in some cases channel alignment. The first cost of developing this type of waterway is generally less than that with other types but requires continuous surveillance and marking of the channel and considerable maintenance. Open-river navigation is maintained on the Mississippi River below St. Louis, the Missouri River, and the Columbia River below Bonneville Dam.

2-8. Canalized Streams. Canalized streams involve the construction of locks and dams to maintain adequate depths for navigation during periods of medium and low flows. Locks and dams would be required in streams having steep gradients with velocities too high for navigation or where conditions make it impractical to develop the required depths naturally because of rock outcrops, sediment movement, and other factors that could adversely affect navigation and flood-carrying capacity of the stream. Even with locks and dams, some channel improvement and regulating and stabilization structures and channel maintenance will be required. The principal disadvantage of this type is high initial cost and delays caused by tows passing through each lock. Canalized waterways usually have lower velocities and greater channel width and depth through most of the reach of the pool during controlled riverflows. Examples of canalized waterways are the Ohio and Monongahela Rivers, Mississippi River above St. Louis, Mo., and the Arkansas River. Locks might also be required in channels through estuaries, bays, near the

mouths of some streams, and in some sea-level canals to prevent salt-water intrusion or minimize the effects of tides and differences in water levels with connecting waterways.

2-9. Canals. Land-cut canals have been used to connect two bodies of water, to bypass rock outcrops and rapids, and to reduce the length or curvature of the navigable channel. Canals can parallel existing streams or continue overland to reach specific destinations. Construction of canals can be expensive depending on the amount and type of excavation, land acquisition, and availablity of disposal areas. When connected to an existing stream or other body of water, locks might be required in the canal. In order to reduce the amount of excavation, canals might be routed through shallow lakes and estuaries. Stabilization structures might be required along the banks of the canal to reduce erosion of the banks due to waves created by traffic and wind. Canals tend to be narrow and shallow to minimize cost and could be affected by surges resulting from lock filling or emptying when relatively high-lift locks are used. Examples of land-cut canals are the Chain of Rocks Canal near St. Louis, Mo., New York State Barge Canal, and the intracoastal canals.

2-10. Basis of Selection. Selection of the type of waterway adopted will depend on the amount and type of traffic that would be developed; characteristic of the equipment in general use; channel alignment and dimensions required; sedimentation problems to be resolved; safety, efficiency, and dependability; environmental effects; and comparative cost of construction, operation, and maintenance.

2-11. Cost Estimates. A series of layouts with cost estimates are needed to develop optimized costs. These life cycle cost estimates should include initial construction cost, maintenance cost, and replacement cost. Each of the layouts is required to move the required tonnage but each will have a different trip time. This trip time is translated into benefits. The comparison of project costs versus benefits will provide the basis for selection of the optimum layout. Generally, fewer locks are cheaper than a greater number of lower-lift locks. Economy should consider both first cost and maintenance and operation cost without sacrifice of safety, efficiency, and dependability.