

CHAPTER 4

PROJECT LAYOUT (SITING OF STRUCTURES)

4-1. General. Detailed guidance on project layout is provided in EM 1110-2-1611. This chapter provides an overview of the major aspects of project layout. Navigation locks and dams are usually required in some streams or canals to provide adequate depths for navigation during low flows without excessive velocities. Lock and dam layout is an iterative process in which the physical, hydraulic, geologic, and other parameters are evaluated for a preliminary layout and necessary adjustments made eventually come up with a feasible layout. The basic tools required to initiate this process are topographic maps, water-surface profiles, geological data, and preferably aerial mosaics that cover the full length of the proposed project. The number of navigation structures required for the system is basically dependent on the stream bed slope and on the levels of the upper pools that can be economically established. Ideally, the pools would be as high as possible to reduce the total number of lock and dam structures, thereby minimizing system transit time. Also, all the pools would have roughly equal heads so that lockage water requirements and operation times at each project are roughly the same. Physical constraints normally prevent attaining these ideal conditions.

4-2. Upper Pool Elevation. The selection of the optimum upper pool elevation will require a detailed analysis of the local terrain; areas subject to flooding; effects on groundwater elevation, drainage, environmental impact; need for raising, relocation, or replacement of existing facilities such as bridges, levees, highways, railroads, sewer lines, etc.; real estate acquisition; and need for dredging and/or training and stabilization structures. In some cases it might be more economical to increase the length of the pool by dredging in the upper reach than by raising the pool elevation. When sediment movement is involved training structures might be required to maintain navigation widths and depths in the dredged area. The ultimate selection of the upper pool elevation and location of the structures has to be based on an economic evaluation of the factors involved and navigation conditions that could result from the proposed project. However, navigation conditions are normally better with high-head pools because velocities are lower and pool fluctuations are less.

4-3. Navigation Considerations. The site selected for each structure can be one of the most important factors in the development of satisfactory navigation conditions. In addition to other factors, the design engineer should consider the reach upstream and downstream of the proposed sites (including current directions and velocities), sediment movement for the various flows possible, effects of the structure on the currents and movement of sediment, and the effects of the resulting currents on the movement of tows approaching and leaving the lock or locks.

4-4. Foundations. The foundation available may have a significant effect on the location and arrangement of the structure. The characteristics of the foundation material determined during the early stages of the investigation should provide some indication of the probability that the structures needed can be constructed at reasonable cost with ordinary design standards and may

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reduce the number of sites available. Movement in the location of the structures because of foundation conditions should not jeopardize safe and efficient navigation conditions.

4-5. Sediment Movement. The effects of sediment movement in a stream should be considered in the evaluation of the location of the structures and the selection of the normal pool elevation. Many of these streams will require some modifications within the pool because of short-radius bends and shoaling in crossings, particularly in the upper reach of the pool. Solution of sedimentation problems requires a knowledge of the sedimentation processes in alluvial streams and methods that can be used to modify these processes to eliminate any undesirable conditions. Heavy sediment movement could have an effect on the length of pool that could be economically developed but would otherwise have little effect on the location of the individual structure. Normally, lock or locks sited to provide good navigation conditions (normally on the outside of bends) should experience no difficulties with shoaling in the upper lock approach. Shoaling can be expected in the lower lock approach because of the sudden expansion in channel width at the end of the riverside lock wall. However, structures have been developed in model studies that can be used to minimize or even eliminate shoaling in the lower approach and thereby minimize or eliminate maintenance costs (see EM 1110-2-1611).

4-6. Channel Rectification. The natural bends in most streams are too sharp and long to establish a safe navigation sailing line for most commercially sized tows. Lock and dam layout needs to consider these channel realignments to be assured of satisfactory approach conditions. Channel realignments should change the natural alignment as little as possible to minimize the changes to the natural flow regime of the stream. Severe regime changes frequently result in the stream not conforming to the proposed alignment. Expensive maintenance problems will result.

4-7. Channel Stabilization. Channel rectification measures normally require channel stabilization structures to coax the stream to assume the realignment. Channel stabilization structures are also useful in the control of sediment deposition tendencies. Through properly placed structures, ultimate channel maintenance dredging can be minimized.