

RESTORATION AND MANAGEMENT(river)

The primary water-quality-related problems encountered in rivers and streams include (1) sedimentation and siltation of habitat; (2) low dissolved oxygen, resulting in fish kills; (3) overuse of riparian areas; (4) stream channelization; (5) drinking-water taste, odor, color, and organics problems; (6) toxic contamination of sediments; and (7) poor fishing.

Techniques that can be used in river and stream restoration are divided into nonstructural and structural techniques. *Nonstructural techniques* are broadly defined as any method that does not require physical alteration of a watercourse or construction of a dam or other structure. *Structural techniques* range from “soft” approaches, such as the use of tree trunks and branches to slow water velocity, to “hard” engineering approaches, such as the use of riprap (A layer of loose large broken stones or broken rock) for bank stabilization.

Nonstructural Techniques

Nonstructural techniques for the restoration and management of rivers and streams typically include administrative or legislative policies and procedures that limit or regulate some activity. The most common nonstructural techniques are as follows:

1. **Flow regulation** consists of reserving or reclaiming flow for in-stream uses such as fishing and recreation.
2. **Plantings** create buffer zones that can be gradually reforested over time through planting of trees and grass. Strips of forest along both banks of a stream protect the stream from polluted runoff, and an example of a typical riparian forest is shown in Figure.



FIGURE 4.14 Riparian forest. (From Stroud Water Research Center, 2005.)

3. *Pollution prevention techniques* include regulating activities in the stream, riparian zone, and surrounding watershed. For example, phasing construction to limit the amount of disturbed area at any given time greatly reduces downstream suspended-sediment levels. The utilization of silt fences, such as shown in Figure, to protect rivers from soil during construction is an effective pollution-prevention technique.



FIGURE 4.15 Silt fence. (From State of North Carolina, 2005a.)

4. *Land acquisition* approaches can lead to the establishment of greenways, buffer strips (أشرطة), and parks. These can be purchased by government or special foundations to provide such protection.

5. *Land-use regulation* in the riparian zone and watershed is an effective legislative approach to controlling pollution sources.

Structural Techniques

Structural techniques for the restoration and management of rivers and streams are those that require some type of physical alteration of the watercourse and may include alterations to existing human-made structures, such as dams and levees (حواجز).

1. Bank armoring techniques use rock, wood, steel, and other conventional construction materials to stabilize stream banks. An example of riprap (rock) stabilization of a stream bank is shown in Figure.



2. Aquatic habitat improvement methods involve improving aquatic habitat through installation of certain in-stream structures. Habitat improvement structures can add gravel beds, restricted flow. These features are important to allow spawning and rearing (تربية) areas for aquatic life.

3. Low-flow augmentation provides cleaner diluting flow during times of water-quality emergencies and/or to sustain proper ecological conditions for fish and aquatic life. The source of the diluting flow may include upstream reservoirs, pumping from nearby water bodies, or recycling (pumping) flows of cleaner and more diluted downstream flows.

4. In-stream and side-stream aeration may be feasible for streams that exhibit low dissolved-oxygen levels. In-stream aeration is accomplished by turbine aeration or by installation of submerged aerators.



5. Removal of river impoundments can be considered restoration techniques. In the United States many dams were built on streams for various purposes more than 100 years ago. Sediment has accumulated behind these dams from urban and rural diffuse sources, wastewater discharges, and from combined sewer overflows. Often, the impoundment today is filled with sediments, has ceased to function, and the sediments contain toxic pollutants.

6. Removal of contaminated sediment