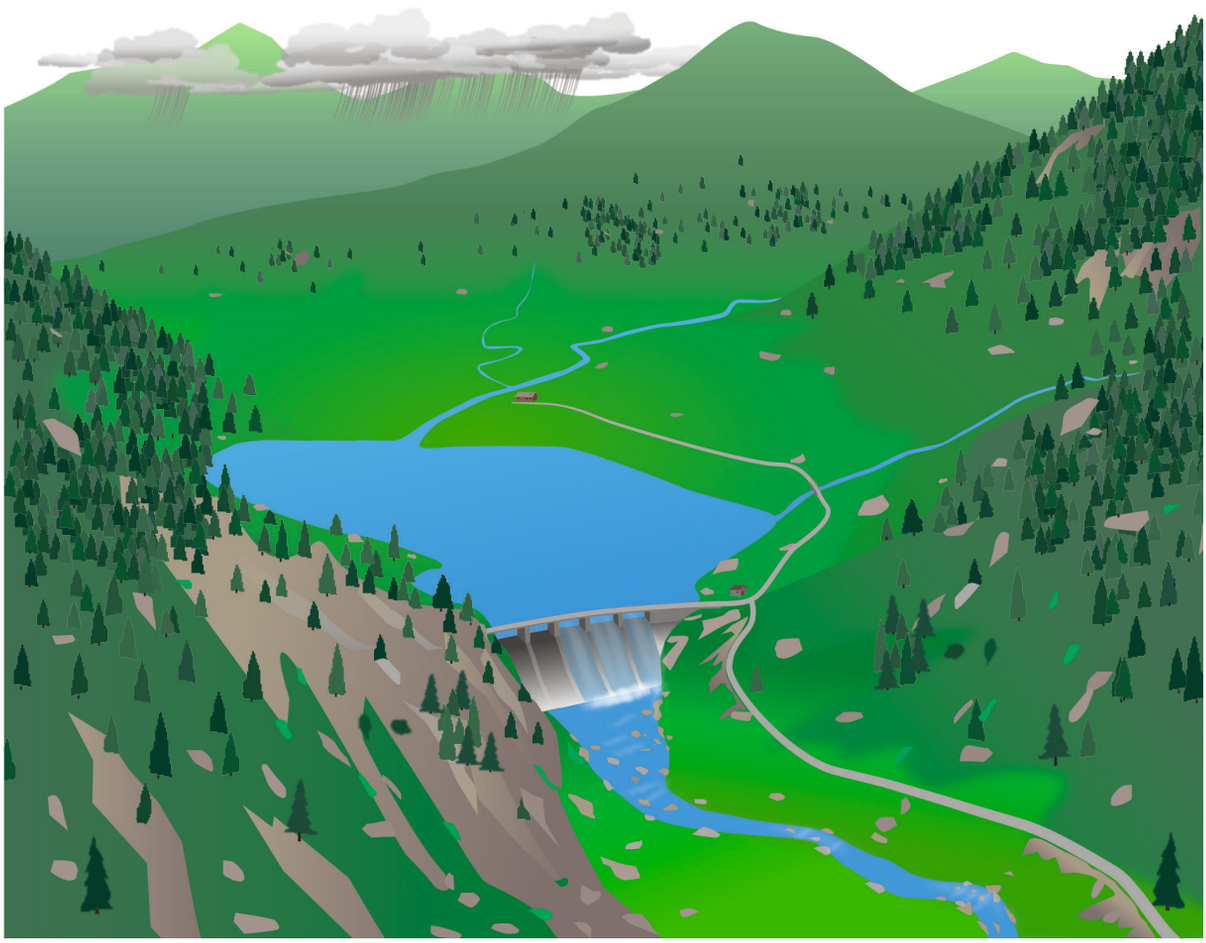
Ponds, Lakes and Reservoirs



A Pond or Lake is a still or slow-moving surface water body formed by surface runoff, river water collecting in a depression or groundwater collecting in an excavated area. They can thus be natural or man-made (e.g. by damming flowing water to form a Lake). Naturally occurring Lakes, Ponds or existing Reservoirs can be useful in acute stages of an emergency where large quantities of water are needed quickly, while planned new Reservoirs may be an option for long-term interventions such as drought mitigation.

Ponds or Lakes may occur naturally in places where ground or bare rock surfaces slope towards a depression that collects rainwater or when groundwater fills a depression or excavation. Reservoirs are depressions that have been enhanced in some way that prevent the water from escaping (e.g. with a retaining wall/embankment or by lining the base of the Reservoir). Naturally occurring Ponds or Lakes are usually open for general public use, whereas access to Reservoirs tends to be controlled or managed (e.g. Reservoirs for town water supplies). The quantity and quality of water that can be obtained from Ponds and Lakes are the main issues to have in mind when considering these as water sources, and in addition for reservoirs there are some important design issues to consider.

Water quantity can be an issue particularly in arid and semi-arid areas due to water losses through evaporation and seepage. Especially in places with low rainfall and long dry seasons, more water may be lost from a Lake than can be replenished, resulting in it drying up within several months. While many larger Reservoirs are not lined or covered due to their size, there are some design considerations that can reduce both evaporation and seepage. For instance, evaporation can be reduced by increasing the volume to surface area ratio via deeper Reservoirs or by planting trees around the Reservoir as a windbreak. Infiltration rates can be reduced by compacting clayey soil in situ to form a lining, or by using an artificial liner (usually expensive and prone to damage by

cattle and sunlight). These measures are only suited for long-term planned interventions when a new Reservoir is to be installed. Smaller Reservoirs are more suited to being lined and covered/shaded.

Water quality is an issue with open surface-water sources, which are open to physical, microbiological or chemical contamination that must be addressed with the proper treatment. Open water can also be problematic for other diseases not directly related to drinking water (e.g. schistosomiasis or insect vector-related diseases). Water quality can be improved using simple measures to reduce treatment requirements, including structures to prevent people from entering the Pond (such as a fence) combined with alternative methods for collecting water (e.g. platforms, bank-mounted extraction devices), abstracting water through Riverbank Filtration **(I.6)** methods or through minimising turbidity by choosing a certain type of intake (e.g. floating intake, **see I.3**). Compared to Rivers and Streams **(S.2)**, though, Ponds and Lakes tend to be calmer, so sediment can settle more before abstraction or treatment.

Technical design is needed for artificial Reservoirs, and earth-filled dams over two metres high need to be specially designed. Issues to consider include the choice of dam material, design of an erosion-resistant spillway, a suitable slope angle for the dam wall, and a rock toe drain to collect seepage water. The structural failure of dams or embankments is often caused by 'piping', which is where seeping water finds a path through a dam wall or foundation and creates channels. Piping is exacerbated by poor compaction, poor choice of materials, tree roots or animal burrows. Siltation, which refers to the deposition of fine sediment in the bottom of a Lake or Reservoir, is another major problem that can be reduced by keeping a good cover of grasses in the runoff area or by using silt traps.

Applicability: In acute emergencies, Ponds and Lakes can quickly provide large volumes of water. They are generally more suited to areas with intense rainfall where there are water availability issues throughout the year. Constructing artificial Reservoirs can take some time, so they are generally not suitable as a new technology for the acute response phase, though where they already exist, they can be rehabilitated quickly for an approaching rainy season.

Operation and Maintenance: O&M-related activities to improve water quality include limiting access and restricting activities in the Pond or Lake, having separate Ponds for drinking water and other activities, having a buffer zone of vegetation between the land and Lake to reduce silt load, and reducing and monitoring industrial effluent or runoff from agricultural areas. For artificial Reservoirs, regular inspection is needed to check for erosion damage to banks/spillway and for evidence of piping through the walls. De-silting will be occasionally needed and can be done manually (e.g. cash-for-work activities that can work well in emergencies) or using oxen or large machinery.

Health and Safety: Microbiological water quality will always be poor in open water, so treatment will be needed. Where runoff from urban or agricultural areas might introduce unwanted chemicals (e.g. pesticides), alternatives for drinking water should be considered. Open water may also be prone to cyanobacterial blooms; here, reducing the nutrient load in the water will help, and Biosand Filtration **(T.9 or H.5)** is a good treatment option for removing cyanobacterial toxins. Open water can also serve as a breeding ground for other water-related diseases. For large Reservoirs with a dam, catastrophic dam failure can result in injury and death, so rigorous design is required.

Social and Environmental Considerations: Generally, Ponds and Lakes are well accepted by users as a water source, despite the poor water quality. They can support the livelihood of pastoralists that move from one grazing area to another, as these areas can all be fed by rainwater dams if well managed. However, impacts on people, aquatic organisms and the ecosystems should always be assessed during the planning phase. The construction of a dam and Reservoir within a river system can greatly impact the people living downstream of the river as well as aquatic organisms, plants and animals, and biodiversity might be irreversibly affected by their construction. Therefore, even for small dams, construction and planning requires coordination with respective authorities **(see X.3)**.

Strengths and Weaknesses:

- ⊕ Provides large amounts of water in water-stressed areas
- ⊕ Can facilitate recharge of local groundwater

- ⊖ Requires treatment for low water quality
- ⊖ Associated with health risks from water-related diseases
- ⊖ Can dry up quickly in areas with long dry season
- ⊖ Regular de-silting may be needed
- ⊖ Competing uses by other communities (or sharing with wild animals or cattle)

→ **References and further reading material for this technology can be found on page 212**