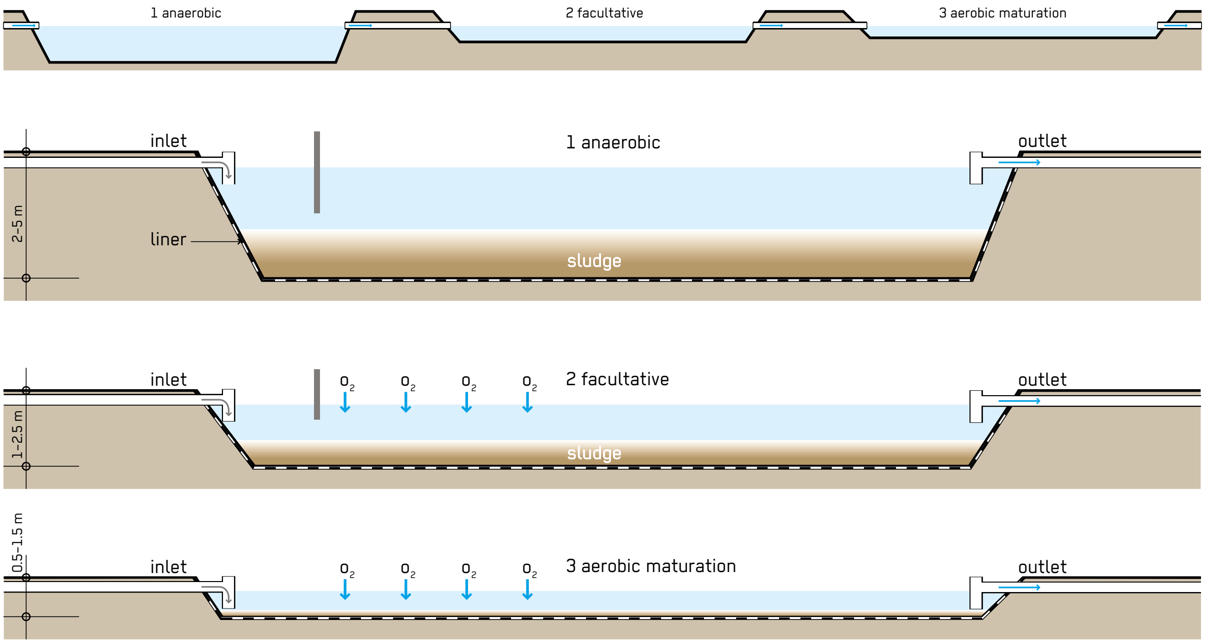
Waste Stabilisation Ponds

Phase of Emergency	Application Level / Scale	Management Level	Objectives / Key Features
Acute Response ** Stabilisation ** Recovery	Household * Neighbourhood ** City	Household * Shared ** Public	Solid / liquid separation, Sludge stabilisation, Pathogen reduction
Space Required	**Technical Complexity**	**Inputs**	**Outputs**
*** High	** Medium	● Blackwater, ● Greywater, (● Sludge)	● Effluent, ● Sludge



Waste Stabilisation Ponds (WSPs) are large, constructed water bodies. The ponds can be used individually, or linked in a series for improved treatment. There are three types of ponds, (1) anaerobic, (2) facultative and (3) aerobic (maturation), each with different treatment and design characteristics.

For the most effective treatment, WSPs should be linked in a series of three or more, with effluent flowing from the anaerobic pond to the facultative pond and, finally, to the aerobic pond. The anaerobic pond is the primary treatment stage and reduces the organic load in wastewater. Solids and biological oxygen demand (BOD) removal occurs by sedimentation and through subsequent anaerobic digestion inside the sludge. Anaerobic bacteria convert organic carbon into methane and, through this process, remove up to 60 % of BOD. In a series of WSPs, the effluent from the anaerobic pond is transferred to the facultative pond, where further BOD is removed. The top layer of the pond receives oxygen from natural diffusion, wind mixing and algae-driven photosynthesis. The lower layer is deprived of oxygen and becomes anoxic or anaerobic. Settleable solids accumulate and are digested on the bottom of the pond. Aerobic and anaerobic organisms work together to achieve BOD reduction of up to 75 %. Anaerobic and facultative ponds are designed for BOD removal, while aerobic ponds are designed for pathogen removal. An aerobic pond is commonly referred to as a maturation, polishing, or finishing pond because it is usually the last step in a series of ponds and provides the final level of treatment. It is the shallowest pond, ensuring that sunlight penetrates the full depth for photosynthesis to occur. Photosynthetic algae release oxygen into the water and consume carbon dioxide produced by respiration of bacteria. Because photosynthesis is driven by sunlight, the dissolved oxygen levels are highest during the day and drop off at night. Dissolved oxygen is also provided by natural wind mixing.

Design Considerations: Anaerobic ponds are built with a depth of 2 to 5 m and have a relatively short detention time of one to seven days. Facultative ponds should be constructed with a depth of 1 to 2.5 m and have a detention time between five and 30 days. Their efficiency may be improved with the installation of mechanical aerators. Aerobic ponds are usually between 0.5 to 1.5 m deep. If used in combination with algae and/or fish harvesting **(D.13)** they are effective at removing the majority of nitrogen and phosphorus from the effluent. Ideally, several aerobic ponds can be built in series to provide a high level of pathogen removal. A good hydraulic design is important to avoid short-circuiting, i.e. wastewater travelling directly from inlet to outlet. The inlet and outlet should be as far apart as possible, and baffles can be installed to ensure complete mixing within the ponds and avoid stagnating areas. Pre-Treatment **(PRE)** is essential to prevent scum formation and to hinder excess solids and garbage from entering the ponds. To protect ponds from runoff and erosion, a protective berm or mound should be constructed around each pond using excavated material.

Materials: Mechanical equipment is necessary to dig ponds. To prevent leaching into groundwater, the ponds should have a liner, which can be made from clay, asphalt, compacted earth, or any other impervious material.

Applicability: WSPs are among the most common and efficient methods of wastewater or effluent treatment around the world. They are especially appropriate for rural and peri-urban communities that have large, unused land, at a distance from homes and public spaces. WSPs are not suitable for the acute response phase due to the long implementation time needed and are more appropriate for the stabilisation and recovery phases and as a longer-term solution.

Operation and Maintenance: Scum that builds on the pond surface should be regularly removed. Aquatic plants (macrophytes) that are present in the pond should also be removed as they may provide a breeding habitat for mosquitoes and prevent light from penetrating the water column. The anaerobic pond must be desludged approximately every 2 to 5 years, when the accumulated solids reach one third of the pond volume. For facultative ponds sludge removal is less and maturation ponds hardly ever need desludging. Sludge can be removed using a raft-mounted sludge pump, a mechanical scraper at the bottom of the pond or by draining and dewatering the pond and removing the sludge with a front-end loader.

Health and Safety: Although effluent from aerobic ponds is generally low in pathogens, the ponds should in no way be used for recreation or as a direct source of water for consumption or domestic use. A fence should be installed to ensure that people and animals stay out of the area and that solid waste does not enter the ponds.

Costs: Investment costs to purchase land and dig the ponds may be high, but operation and maintenance costs are relatively low.

Social Considerations: The anaerobic pond(s) may generate bad odours. It is thus important to locate the ponds far from settlements. Alternatively, the surface of anaerobic ponds can be artificially aerated. Due to algae growth in the aerobic ponds, the effluent may look very green.

Strengths and Weaknesses:

⊕ Resistant to sudden loads of organic material or flow increases
⊕ High reduction of solids, BOD and pathogens
⊕ Low operating costs
⊕ No electrical energy is required

⊖ Requires a large land area
⊖ High capital costs depending on the price of land
⊖ Requires expert design and construction
⊖ Sludge requires proper removal and treatment

→ **References and further reading material for this technology can be found on page 194**