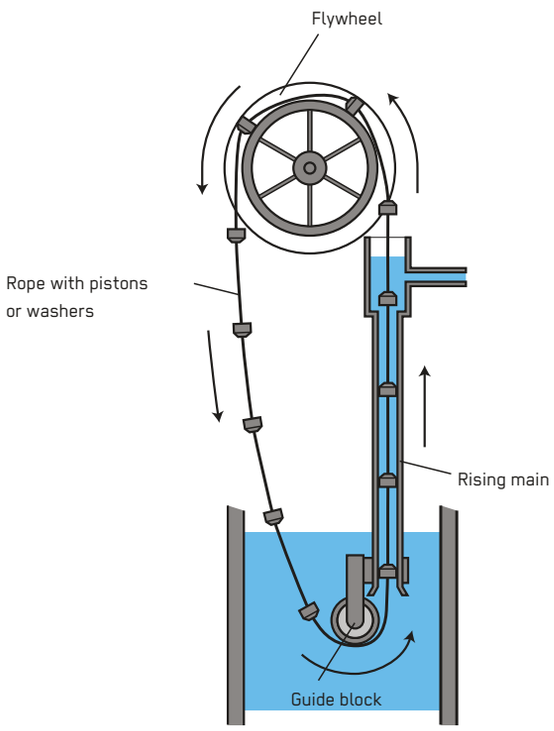
Rope Pump

Response Phase	Application Level	Management Level	Objectives / Key Features
Acute Response * Stabilisation ** Recovery	** Household ** Neighbourhood City	** Household ** Shared * Public	Positive displacement pump, simple shallow lift handpump
Local Availability	**Technical Complexity**	**Maturity Level**	
*** High	* Low	*** High	



A Rope Pump (also known as a rope and washer pump) is a positive displacement pump that displaces a fixed amount of water per cycle. Water is lifted directly using the continuous movement of a flywheel moving in one direction (rather than in a reciprocating manner). Components below ground are mostly made from plastic, making them corrosion resistant and easier to maintain. These pumps are usually not suited to the acute response phase, and are more for long-term water supply in rural areas, where they are good for upgrading open wells and disused boreholes to improve access and water quality.

Rope Pumps are usually manually operated, but may also be motorised. They function using a loop of rope with washers attached, which connects the flywheel at the top to a flared entry point to the rising pipe at the bottom. The washers fit only loosely within the rising pipe, but this is enough to ensure that at a certain rotational speed, more water is lifted than falls by gravity around the washers, with the net result that water is transported into the pump head.

Design Considerations: There are several key features of a Rope Pump. The flywheel has two handles, one on each side, meaning it can be operated by either one or two people. A loop of rope connects the flywheel above ground to a guide below the water surface. A metal flywheel is often joined with two sides of old tyres, which help grip the rope and washers within its central groove. Nylon rope may be used, although it tends to slip and stretch more than polypropylene (PP). Washers are spaced on the rope at a minimum of 1 metre intervals (to avoid slippage on the flywheel) and are supported and restricted by two knots around each washer. Washers tend to be made from either moulded high-density polyethylene (HDPE) pieces or rubber discs cut from car tyres.

For Protected Dug Wells **(I.7)**, the rope enters via a point on the slab and makes its way to a guide situated under the rising main pipe, though there is also a borehole version where the rope is funnelled after it leaves the flywheel by an above-ground guide that brings it closer so it will enter a narrow borehole (even down to 75 mm diameter is possible). The rope descends into the well without

a pipe and is then caught by a flared catcher pipe that is part of the guide structure at the base of a rising pipe. Its function is to guide the rope back into the bottom of the rising main pipe, which is also flared. Having flared ends helps prevent the rope or washers from catching on the end of the pipe and damaging it while making the pumping motion smoother. Finally, the rising main, which can have a diameter of between 18 to 40 mm depending on the lift, is connected with the pump head and spout.
Manually operated rope pumps can be used for water depths up to 50 metres, while they have also been motorised for depths up to 100 metres. Flow varies on the lift and pumping method. Manual pumps at 5 metres depth can give around 5,000 L/hour, which is reduced to 500 L/hour at 50 metres depth, while motorised pumps at 100 metres depth can give 1,100 L/hour.

Materials: The Rope Pump can be produced with locally available materials and skills using small workshops or can be purchased from specialist manufacturers. Materials needed include the pump head (metal), rising pipe (plastic), rope with washers, a flywheel, handles, and rope guides. In many cases, this type of pump is produced locally, but this is not true in all countries. Availability will depend on country context.

Applicability: Rope Pumps are mainly suited for household use or in the context of rural community water supplies, rather than in emergencies and/or urban settings where there are dense populations and where manual water extraction from a single shared source may not meet the volume demand **(see S.8)**. The pump is more suited to a low number of users (e.g. up to 50) due to the plastic materials that are not very robust. It is used mainly for drinking water or for irrigation and watering livestock and can be useful for increasing the yield from hand-dug wells or providing a hygienic collection system for a surface water source in an emergency.

Operation and Maintenance: Although all hand-powered pumps require a comprehensive strategy for maintenance due to the high level of usage and wear and tear, O & M is easier for Rope Pumps than other handpumps due to the simple design. There are fewer parts with no levers or bearings (apart from models that have bearings on the flywheel axle), which results in fewer pump maintenance issues. Also, the use of plastic pipes and fittings means that extracting pipes is easier and more straightforward than for metal pipes (total weight of around 15 kg, 5–10 times lighter than other piston pumps). Also, all parts can be manufactured locally, contributing to sustainability. Maintenance of the underwater components is also reduced, as they are made from plastic and are therefore resistant to corrosion by groundwater with a low pH. Certain parts will, however, require replacement at some point (e.g. washers or ropes), though these are easily replaced and can be manufactured on site most of the time. While the design lends itself to easy maintenance, the reality is that even these pumps are not maintained as needed, for reasons usually separate from the pump design **(see S.8)**.

Health and Safety: Since most of the below-ground components are made from plastic, there are fewer concerns about the solubility of metals in lower pH water and any related direct and indirect health consequences. There is a small risk of microbiological contamination at the point where the rope is exposed within the pump head, and some designs mitigate this through a pump head cover.

Costs: Manually operated Rope Pumps tend to cost between 50–170 USD depending on context. Ongoing costs are very low (around 20 USD or less per year per pump) since parts can be made locally — this is a lot less than many other handpump types. Any repair to metalwork is easily done if there is a local workshop with welding capabilities.

Social and Environmental Considerations: These types of pumps are very well accepted by people where they have been installed. As this type of pump is mostly applied in its manual version, it represents an environmentally friendly way of water extraction, with limited risk for over-exploiting the water source used for pumping.

Strengths and Weaknesses:

⊕ Lower O & M requirements than deep well pumps due to fewer working parts and plastic components
⊕ Relatively easy access to pipes and valves below ground
⊕ Low cost for purchase and maintenance
⊕ Can be manufactured locally

⊖ Pump design not suited to too many users
⊖ Possible risk of contamination through touching the rope
⊖ No foot valve, meaning the raising main needs to be filled with water each time pumping starts

→ **References and further reading material for this technology can be found on page 216**