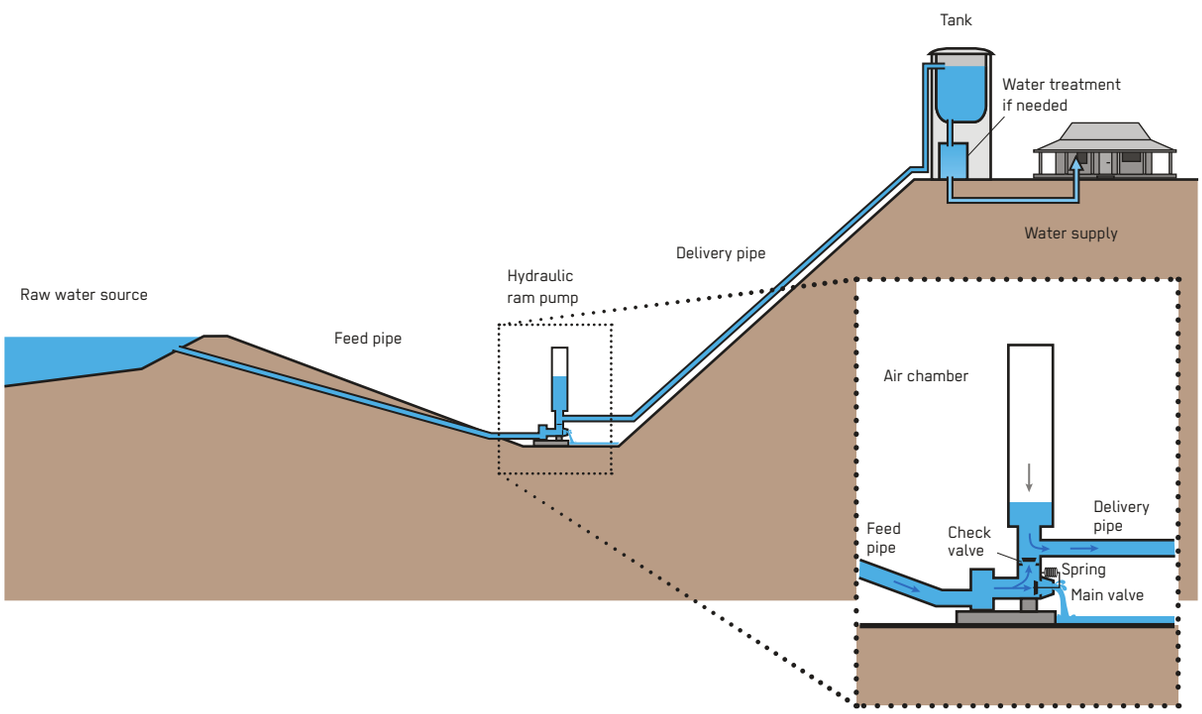
Hydraulic Ram (Impulse) Pump

Response Phase	Application Level	Management Level	Objectives / Key Features
* Acute Response ** Stabilisation ** Recovery	** Household * Neighbourhood City	** Household * Shared Public	Impulse pump, pumping and transport of water, use of energy from the water
Local Availability	**Technical Complexity**	**Maturity Level**	
** Medium	* Low	*** High	



Hydraulic Ram or Impulse Pumps convert the difference in elevation between the feed pipe intake (e.g. from a nearby river or flow from an elevated reservoir) and the pump itself into kinetic energy that moves water through the delivery pipe. Impulse Pumps require little to no energy input other than a flowing water source and can reliably provide pressurised water from that existing source (including spring water). This technology is mainly applicable during the stabilisation and recovery phases of an emergency.

A Hydraulic Ram Pump uses a series of one-way valves and a compressible pocket of air to harness the energy (or impulse) from a flowing stream, river or reservoir discharge located at a higher elevation than the pump itself. The flowing water compresses the air pocket, which in turn forces a small amount of water through the pump discharge at a higher pressure. Most of the energy from the inlet flow velocity is transferred to the compressed air pocket, with only a small fraction of the inlet flow being pumped onwards, which results in it being propelled at a higher pressure.

Design Considerations: A Hydraulic Ram Pump does not need electricity or fuel for operation, instead relying on a natural flow and elevation difference. Water can be pumped from 20–40 times higher than the available height difference driving the pump, meaning that a height difference of 1 metre in the feeding pipe can pump water over 30 metres upwards in the delivery pipe. However, less than 10 % of the water volume flowing through the feeder pipe can be delivered to the outlet, as the energy for lifting the water to the outlet including losses is taken from water escaping the pump through the main valve. The minimum water flow rate required is 7–10 litres per minute for small pumps, and the minimum working fall is 1 metre.

Materials: The availability of ready-made Hydraulic Ram Pumps is regionally dependent (lighter pumps are available in Asia with a reasonable working life). While the design is simple enough to allow for homemade assembly using locally available valves, thermoplastic pipes and fittings, homemade versions tend to be unreliable. Ram pumps may be fabricated from HDPE or other thermoplastic components and commodity fittings (PVC and other brittle materials should be avoided).

Applicability: A Hydraulic Ram Pump is most suitable for hilly or mountainous areas where water sources are situated lower than the point of use. Generally, streams, rivers or springs can be used as a source to operate these pumps, but a sufficient flow/capacity is needed to operate them, as a large portion of the water serves as an energy source that then exits below the pump and returns to the water source. Commercial pumps are reliable but are only available in sizes capable of producing water at low flow rates. There are no widely available, commercial products for neighbourhood scale or larger. The best application of Hydraulic Ram Pumps may be for agricultural or livestock needs near a river. The major drawback is the low efficiency and wastage of these pumps, along with their relatively low flow. The pump may provide a simple alternative to pump water for agricultural purposes from a nearby stream or river with no additional power requirements.

Operation and Maintenance: A Hydraulic Ram Pump will operate 24 hours a day, 7 days a week for many years with no external power requirement. Regular maintenance of the main valve and the check valve is required to ensure longevity, and the air in the air vessel must be regularly checked and refilled. Apart from that, minimal maintenance is needed. Although it requires no external power source, it does need a continuous inflow of water from the source. It is recommended to check the performance of the ram pump once a month. Inlet filters on the feed pipe may require daily or weekly checks and cleaning, depending on the available water quality.

Health and Safety: There are relatively few risks associated with Hydraulic Ram Pumps. PVC and other brittle materials should be avoided when used with compressible fluids. As the system runs on renewable energy, environmental impacts are considered negligible. Where the Hydraulic Ram Pump uses surface water (e.g. from a river), care must be taken for proper water treatment.

Costs: Homemade Hydraulic Ram Pumps are relatively cheap and comparable to the available HDPE piping and fittings required to install them. Commercial pumps, especially with metal components, will be more expensive, although they will be more robust and offer a longer life cycle than locally fabricated options. Actual costs differ due to factors such as size and geography. An indicative price is in the range of 150–400 USD.

Social and Environmental Considerations: Some technical capacity is needed to fabricate and troubleshoot a Hydraulic Ram Pump. As the periodical closing of the main valve creates a clicking sound, Hydraulic Ram Pumps may be heard over some distance. It is therefore recommended that they be located away from houses and public buildings such as schools and health centres. The Hydraulic Ram Pump is a renewable energy water-pumping technology, which harnesses the energy contained within flowing water to pump a portion of that water to a higher elevation. No other energy is required as long as there is a continuous flow of water, which makes it an environmentally friendly pumping application.

Strengths and Weaknesses:

⊕ Simple technology
⊕ Fabricated using readily available materials from the local market
⊕ Requires no power input

⊖ Produces low flow rates
⊖ Often not readily available in commercial sizes

→ **References and further reading material for this technology can be found on page 215**