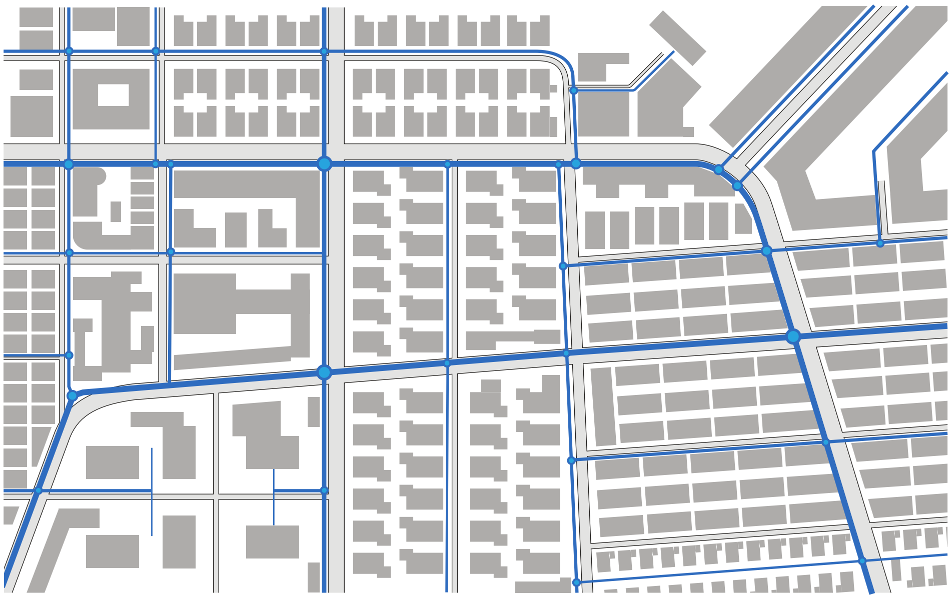
Large-Scale Distribution System

Response Phase	Application Level	Management Level	Objectives / Key Features
Acute Response ** Stabilisation ** Recovery	Household ** Neighbourhood ** City	Household ** Shared ** Public	Distribution at large scale using gravity or pumps
Local Availability *** High	**Technical Complexity** *** High	**Maturity Level** *** High	



Large-Scale Distribution Systems transfer water from a source or treatment facility via pipes to the final distribution point (communal or household taps) using different means of energy, such as gravity or pumps. In an emergency context, these are systems that already exist, but may need repair or rehabilitation.

The components of Large-Scale Distribution Systems are similar to Community Distribution Systems **(D.7)**, differing mainly in scale. Large-Scale Systems will typically serve urban communities and have more complex pipe design, more pumping and more storage facilities covering different areas. They will also have a greater density of connections at a household level.

Design Considerations: Large-Scale Distribution Systems tend to be looped systems which have the advantages of less head loss, fewer dead legs and greater flexibility for pipe repair without affecting the entire system. Design considerations are similar to Community Distribution Systems **(D.7)**, though at a larger scale. This means a tendency for a higher overall water demand due to the larger population served, an increased water demand per household (the more convenient the source, the higher the water use), an increased water demand from industry, public organisations, businesses and firefighting, and significantly more water unaccounted for (e.g. due to leaks and unauthorised connections). Water meters are needed to measure consumption and bill accordingly. Emergency workers may become involved with carrying out emergency repairs and rehabilitation of existing systems. Existing systems are usually operated by some other entity, so it is important to liaise with them before starting any work.
For smaller systems with tapstands and queues **(D.7)**, the design usually assumes all taps are open during peak hours. For slightly larger systems with no queues, the average flow (over 24 hours) is usually multiplied by a peak flow factor according to the number of taps in the system. With larger systems still (over 250 taps), the difference between the average flow and instantaneous flow will be similar,

and design can be based on the average flow multiplied by an average peak flow factor of 2.5, to which is added any additional factor for increased use during certain months of the year. In many cases, the overriding design factor for larger systems can be the water flow required for firefighting, as it can be far greater than peak flow needed for other uses. Standards vary, but typically a design considers supplying water to fight a fire for two hours, where the flow itself is determined by the population size. However, any design for firefighting needs to be made according to what is available to fight fires (e.g. availability of fire trucks).

Materials: Large-Scale Distribution Systems will require similar materials but in greater quantities than Community Distribution Systems **(D.7)**. Local availability depends on the design and the particular context.

Applicability: In an emergency where Large-Scale Distribution Systems are relevant, they will already exist, so work will involve repair or rehabilitation of a part of the system rather than design and construction of a new system. The exact parts in need of rehabilitation will depend completely on the emergency context. For example, where power has been disrupted, issues can occur with those parts requiring a power supply (e.g. pumping stations or treatment plants), or where a natural disaster has occurred, any part of the system could be affected (e.g. distribution network, pumping stations, power lines and treatment plants). In addition to the damage caused by the emergency, there may also be issues with a system that was old and possibly poorly maintained before the emergency occurred, or concurrent urgent issues with the wastewater system. Rehabilitation work may therefore be needed on both wastewater and water systems, while addressing both chronic issues and problems due to the acute emergency.

Operation and Maintenance: All tasks related to Community Distribution Systems also apply to larger systems, the difference being the scale and complexity. There will generally be more equipment that needs maintenance (e.g. more pumping stations, **see A.10**), the equipment might be more onerous to maintain (e.g. larger pumps) and leak management may require more advanced leak detection equipment. As such, these systems can be technically very complex, demanding advanced engineering skills related to urban water supply systems that are often beyond the scope of engineers whose experiences might be limited to the humanitarian sector. A major issue is knowing where all the pipes are and how they are connected, and because full maps of Large-Scale Distribution Systems are rarely available, it is important to link up with existing employees with respective knowledge.

Health and Safety: Larger systems tend to have an uninterrupted water pressure, so the risks from contamination through leaks is less but should not be neglected.

Costs: Rehabilitation capital costs can be very high with larger systems and will vary depending on what rehabilitation work is required. The following two examples give some indication. In Zimbabwe, rehabilitation of a smaller urban water distribution system serving 80,000 people was estimated to cost around 30 USD per inhabitant (where most of the work involved repair and replacement of pumping stations and parts of the water treatment works), while rehabilitation of a larger urban system serving 1 million people was estimated at costing around 13 USD per inhabitant (where work involved pumping stations, water/wastewater treatment plants and sewer replacement). After an emergency, ongoing running costs will need to be met. Larger-scale systems are often financed by user tariffs, yet after an emergency, tariff systems may have broken down. Getting these payment systems restarted will be an essential task if any rehabilitation work is going to be sustainable. Ongoing costs will be significant in these systems, so it may be better to design out or reduce the need for pumps during rehabilitation work where possible and/or to opt for solar pumping **(see S.10)**.

Social and Environmental Considerations: Since these systems generally predate the emergency, there should be no social or cultural issues to overcome. The aim should be to ensure an equitable supply, with particular focus on the requirements of vulnerable groups or access to informal settlements. Household connections may considerably increase water consumption (and wastage) and require subsequent management systems for grey or black water. Illegal pipe tapping can also be an issue.

Strengths and Weaknesses:

- (+) Can result in better hygiene and health due to higher water use with more household connections
- (+) Can assure water quality compared to community distribution systems, since collection and storage contamination pathways are removed
- (+) Tends to have continuous supply, meaning less contamination in the distribution network
- (+) Used mainly by urban residents who can afford tariffs, which can pay for the ongoing operation

- (−) Requires significant capital cost for rehabilitation works
- (−) Requires a comprehensive detailed plan to account for scale and complexity of large systems, which is not always easy given existing data constraints
- (−) May be hard to restart cost recuperation systems after an emergency where personal resources are stretched

→ **References and further reading material for this technology can be found on page 220**