Mykolaiv Water Hub

Water Leaders Course

National University of Water and Environmental Engineering

Newcastle University

University of Maryland

FUNDED BY

European Bank
for Reconstruction and Development

Module 1 – Water

Drinking Water Infrastructure

Drinking water infrastructure forms the system that delivers treated drinking water from treatment facilities to homes, business and other customers

Understanding how distribution systems operate is essential for maintaining reliable supplies, managing demand, reducing water losses and ensuring resilience

This presentation provides an introduction to the key concepts involved in drinking water distribution infrastructure

Overview:

- Water distribution networks
- Water Storage
- Pressurised flow and pumps
- Supply demand
- Leakage and water loss
- Supply resilience

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Drinking Water Infrastructure

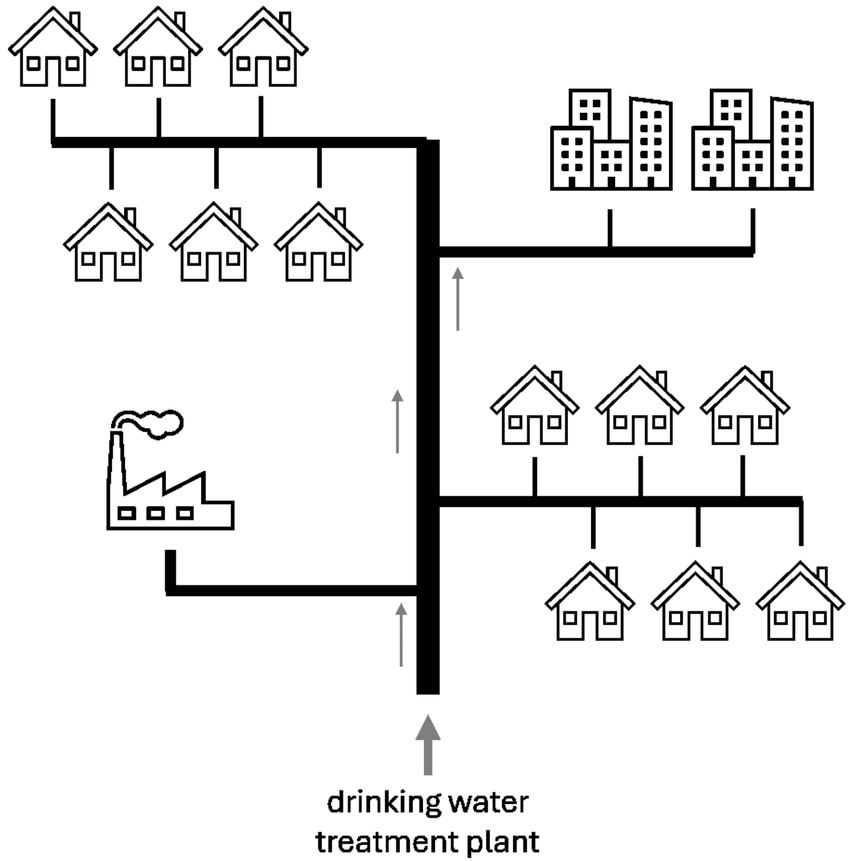
Water Distribution System

Water distribution systems are networks of underground pipes that transport treated water from treatment works to homes, business and other consumers

If required some networks may also include **pumps** and **storage facilities**

Treated water enters the distribution network either directly from a treatment plant or from a storage facility following treatment, before being conveyed throughout the supply area

As water moves though the network, **large transmission mains** feed smaller **distribution pipes** that deliver water to local communities or individual properties



Drinking Water Infrastructure

Purpose of Water Distribution System



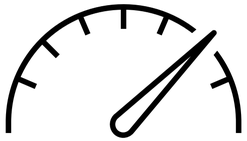
Supply

Deliver sufficient water to meet customer demands



Quality

To provide clean water, maintaining drinking water quality from treatment works to tap



Pressure

Provide water at an appropriate pressure for customer use

Drinking Water Infrastructure

Service reservoirs and water storage

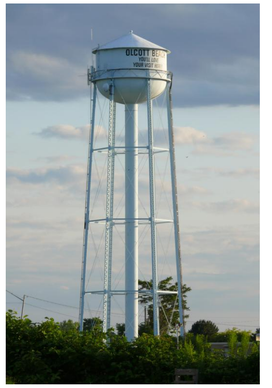
Service reservoirs and other water storage facilities provide temporary storage of treated drinking water, usually between the treatment stage and the distribution network

Storage facilities help:

- **Balance variations** between water supply and customer demand
- **Maintain network pressure**
- **Provide emergencies or maintenance reserves**

To protect **water quality**, storage facilities are designed to minimise contamination risks and are regularly inspected, monitored and maintained

WATER TOWER



Olcottwatertower.jpg, Wikimedia Commons, by Ad Meskens, [CC-BY-SA-3.0]

SERVICE RESERVOIR



Gellerthegyivizarozo-medence1.jpg, Wikimedia Commons, [CC-BY-SA-3.0]

STORAGE TANK



WaterStorageTankaboveWeir,Rossendale-geography.org.uk-129631.jpg, Wikimedia Commons, by michael ely, [CC-BY-AS-2.0]

Drinking Water Infrastructure

Pressurised flow

Water distribution systems operate under **pressure**, allowing treated water to be conveyed throughout the network and delivered to customers' properties

Maintaining pressure helps:

- **Transport water** across long distances and higher elevations
- **Water supply reliability**
- **Deliver sufficient flow** for customer water use and firefighting

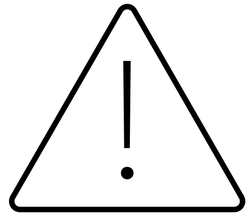
Poor pressure management can lead to low customer pressure, increased leakage, pipe bursts and increased risk of contamination



Showercloseup.jpg, Wikimedia Commons, by tanakawho, [CC-BY-2.0]



Lawnwaterhosesprinkler600x800(1).png, Wikimedia Commons, by TCAtexas, [CC-BY-SA-3.0]



Drinking Water Infrastructure

Pumping stations

Pumping stations are one of the main ways that **pressure** is created and maintained within the water distribution network

A pump is a mechanical device that adds energy to water increasing its pressure pushing it through the pipe network

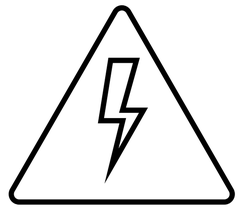
Pumps are required at specific points where **gravity alone cannot provide sufficient pressure**, particularly when moving water to **high elevations** or over **long distances**

Due to their mechanical nature pumps require **regular maintenance** to ensure reliable operation

Compared to the rest of the water distribution system which operates passively relying on gravity, pumps require **electrical energy** to operate meaning they are a significant contributor to the operation energy use of system



Abandonedelectricwaterpump-IMG1056.jpg, Wikimedia Commons, by Bijay Chaurasia, [CC-BY-SA-4.0]



Drinking Water Infrastructure

Customer demand and demand patterns

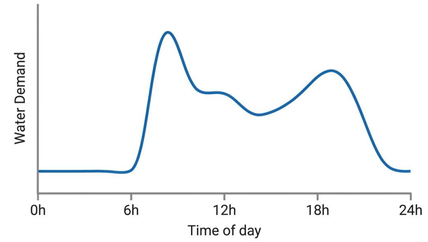
Customer demand refers to the volume of water required by homes, businesses, industry and any other users connected to the water distribution network

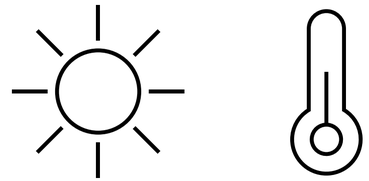
Water use varies throughout the day, with **diurnal demand patterns** typically characterised by peaks in the morning and evening and lower demand overnight

Demand also changes throughout the year, with **seasonal demand patterns** influenced by factors such as weather, tourism and outdoor water use, often resulting in high demand during the warmer months

The distribution network must be able to provide water to customers during both average and **peak demand periods** , so understanding these demand patterns is key when managing water distribution network operations









Drinking Water Infrastructure

Leakage and water loss

Leakage and water loss occur when water escapes from the distribution network before reaching customers

Water loss events range from **small leaks** at a joint or valve to a **major pipe bursts**

Due to the network's pressurised nature, leaks can cause:

- **Large volumes** of water loss
- **Damage to surrounding infrastructure**
- **Disruption to water supplies** through pressure loss

Common causes of leakage or breakage include ageing infrastructure, high pressures, ground movement or asset degradation

Monitoring and proactive maintenance are essential for reducing losses and preventing major incidents



LeakingPVCPipeUnderSink-Ptrap(52842956605).jpg, Wikimedia Commons, by Tony Webster, [CC-BY-2.0]



Burstwatermain(geograph2646387).jpg, Wikimedia Commons, by Richard Webb, [CC-BY-SA-2.0]

Drinking Water Infrastructure

Supply resilience

Supply resilience is the ability of a water distribution system to maintain reliable supply of water under a range of operating conditions, including maintenance activities and unexpected incidents

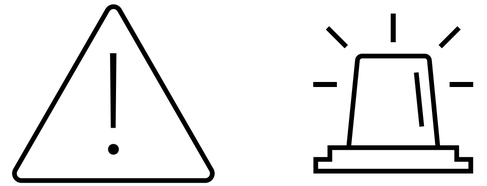


Drippingfaucet1.jpg, Wikimedia Commons, by Dschwenr, [CC-BY-Sa-2.5]

Key resilience measure include:

- **Network redundancy** through alternative supply routes
- **Water Storage** to provide water during outages
- **Backup pumps and power supplies**
- **Emergency response plans** for incidents and extreme events

Together these measures help minimise supply interruptions and maintain service to customers during planned and unplanned events



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