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D.T1.3.1 Technical Training Manual on Urban Circular Water Management for Municipalities

fbr, Association for Rainwater Harvesting and Water Utilisation

MODULE 1: INTRODUCTION

- Goals and challenges
- Benefits of circular water management
- Regulatory & technical frameworks for water reuse
  - EU policy on water reuse
  - WHO Guidelines on water reuse
  - German policy on water reuse
  - New Alternative Sanitation Systems (NASS)

INTRODUCTION

- By 2030, the world may face a 40% gap in water supply vs demand
- Although water scarcity is more pronounced in southern Europe, it is becoming increasingly significant in other parts of the EU
- The linear model of the water supply and disposal systems is no longer suited for the needs of today's rapidly changing societies
- To meet these needs, the water pathway should be developed as a closed loop system with optimal reuse for cost-effective, sustainable, circular solutions with low environmental impact and high efficiency
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Reduce - Recycle - Reuse -

INTRODUCTION

What are the goals of circular water management?

- Protect and conserve fossil water resources for future generations
- Secure water supply and improve water quality
- Reduce water use, recycle and reuse wastewater to alleviate water scarcity
- Reduce impervious surfaces and structures
- Retain water as long as possible on site (no drainage into sewer)
- Induce more evaporation in the city to improve the micro-climate
- Promote multiple water use and water sustainability
- Implement on-site separation of wastewater (dual-piping) and its uptake in the building regulations

INTRODUCTION

Challenges facing the water sector

- Impact of climate changes (changes in precipitation patterns, increase in severe rain and flood events, longer dry periods, …)
- Impact of demographic changes on pipeline-bound structures
- Water & resource scarcity and the need to manage demand
- Water pollution and quality deterioration (nitrates, chemicals, pharmaceuticals, …)
- High energy demand of the end-of-pipe water systems
- Need to improve resource efficiency
- Urbanisation and increase in sealed surfaces
- Urban heat island effects on health and ecological systems
- Lack of risk & disaster management

INTRODUCTION

How to raise public awareness on circular water management?

- Promote transparency on water quality data and the real costs of the communal water and wastewater management
- Spread knowledge on importance of saving and reusing water to cope with its scarcity and ensure sustainability
- Organise public awareness campaigns on water reuse and conservation
- Use traditional and social media to disseminate knowledge and information
- Organise workshops, public events, stakeholder dialogues, etc.
- Creative presentation of water-saving devices and measures
- Educational and promotional material for Kindergarten, schools, etc.
- Other means such as economic incentives, for example, free installation of water meters, …

Benefits of circular water management

Water reuse, as an alternative water source can provide significant economic, social and environmental benefits. These include:

- Increased water availability and security, especially in dry periods
- Reduced over-abstraction of surface and groundwater
- Reduced energy consumption compared to using deep groundwater resources, water importation or desalination
- Reduced nutrient loads to receiving waters
- Increased agricultural production and food security
- Enhanced environmental protection and conservation
- Increased employment and local economy

REGULATORY FRAMEWORK

EU policy on water reuse

Guidelines or standards which regulate water reuse at the European Union level are almost absent. However, EU legislation allows and encourages water reuse through two instruments:

- The **Water Framework Directive (2000/60/EC, WFD):** establishes a legal framework to guarantee sufficient quantities of good quality water across Europe for different water uses and environmental quality. It lists water reuse as a possible measure to be included in the programmes of measures for each river basin

- The **Urban Wastewater Treatment Directive (91/271/EEC, UWWTD):** **Article 12** requires that „treated wastewater shall be reused whenever appropriate“ and „disposal routes shall minimise the adverse effects on the environment“, with the objective of protecting the environment from the adverse effects of wastewater discharge

REGULATORY FRAMEWORK

Most representative standards on water reuse from EU Member States

Despite the lack of water reuse criteria at the EU level, several Member States have produced their own legislative frameworks, regulations or guidelines for water reuse applications.

Country	Standards reference	Issuing institution
Cyprus	Law 106 (I) 2002 Water and Soil pollution control and associated regulations KDP 772/2003, KDP 269/2005	Ministry of Agriculture, Natural resources and Environment Water development Department (Wastewater and reuse Division)
France	JORF num.0153, 4 July 2014 Order of 2014, related to the use of water from treated urban wastewater for irrigation of crops and green areas	Ministry of Public Health Ministry of Agriculture, Food and Fisheries Ministry of Ecology, Energy and Sustainability
Greece	CMD No 145116 Measures, limits and procedures for reuse of treated wastewater	Ministry of Environment Energy and Climate Change
Italy	DM 185/2003 Technical measures for reuse of wastewater	Ministry of Environment Ministry of Agriculture, Ministry of Public Health
Portugal	NP 4434 2005 Reuse of reclaimed urban water for irrigation	Portuguese Institute for Quality
Spain	RD 1620/2007 The legal framework for the reuse of treated wastewater	Ministry of Environment Ministry of Agriculture, Food and Fisheries, Ministry of Health

REGULATORY FRAMEWORK

Bathing Water Directive (2006/7/EC): Concerning the management of bathing water quality and repealing Directive 76/160/EEC

- Regulates the quality of bathing water in Europe (e.g. bathing areas, fishing, boating) with respect to physical, chemical and microbiological parameters
- The main concern is the risk of public health caused by pathogens
- Makes use of only two bacteriological indicator parameters, but sets a higher quality standard
- Focuses on *E. coli* and intestinal enterococci which are limited to 500 and 200 CFU/100 ml, respectively

REGULATORY FRAMEWORK

Proposal for a regulation of the European Parliament and of the Council on minimum requirements for water reuse

Proposal (2018) 337, 28.5.2018

Applies **solely** for:

- Agricultural irrigation
- Aquifer recharge

- Responsibility lies by operators of reclamation plants
- Four water quality classes are defined on basis of relevant crop and irrigation methods
- Defines physico-chemical and microbiological parameters
- Includes a risk management approach and data transparency for water reuse
- Supply of reclaimed water is conditional on permits to be issued by competent authorities of the Member States

REGULATORY FRAMEWORK

Proposal (2018) 337, 28.5.2018

Table 1 – Proposed reclaimed water quality classes

Water quality class	Crop category	Irrigation method	Indicative treatment process*
A	Root crops consumed raw; food crops where the edible part is in direct contact with reclaimed water; other food crops	All methods	Secondary, tertiary and advanced treatment
B	Food crops consumed raw, where the edible part is produced above ground and is not in direct contact with reclaimed water; processed food crops; non-food crops, including crops to feed milk- or meat-producing animals	All methods	Secondary and tertiary treatment
C		Drip irrigation only	
D	Industrial, energy, and seeded crops	All methods	

Regulatory framework

Source: European Parliamentary Research Service

REGULATORY FRAMEWORK

Proposal (2018) 337, 28.5.2018

Table 2 – Proposed reclaimed water quality requirements

Water quality class	Quality requirements				
	E. coli, cfu/100 ml	Biological oxygen demand (BOD_5), mg/l	Total suspended solids (TSS), mg/l	Turbidity (NTU)	Other
A	≤10*	≤10	≤10	≤5	*Legionella spp.*: <1,000 cfu/l where there is risk of aerosolisation in greenhouses Intestinal nematodes (Helminth eggs): ≤1 egg/l for irrigation of pastures or forage
B	≤100	25 mg/l O_2**	35 mg/l**	-	
C	≤1 000			-	
D	≤10 000			-	

*or under detection limit; ** as set in the Urban Wastewater Treatment Directive (annex I, Table 1)

Source: European Parliamentary Research Service

REGULATORY FRAMEWORK

WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater in Agriculture (WHO, 2006)

Volume 1 Policy and regulatory aspects

Volume 2 Wastewater use in agriculture

Volume 3 Wastewater and excreta use in aquaculture

Volume 4 Excreta and greywater use in agriculture

REGULATORY FRAMEWORK

WHO guidelines for reclaimed water for irrigation

- Constitute a tool for an integrated, preventative management of wastewater from the point of wastewater generation to consumption of products that have been exposed to recycled water and excreta in agriculture and aquaculture in order to maximize the protection of public health and the beneficial reuse of these resources
- They do not constitute a regulatory framework in themselves, but provide guidance on how to set one up
- Use a risk management framework, rather than simply relying on post-treatment testing as the basis for managing reclaimed water schemes
- Treatment technologies are dependent upon the end uses of the water and especially, the potential for human contact during production and consumption of the crop

Water reuse for irrigation (Germany)

- Quality requirements for irrigation water are regulated by DIN 19650 (1999), which address hygienic/microbiological concerns of irrigation water in agriculture, horticulture, landscaping as well as in parks and sports facilities
- The quality requirements for irrigation water are significantly more stringent than those for toilet flushing
- The application of the standards according to DIN 19650 is recommended for private households. However, treatment of the greywater is indispensable

DIN 19650:1999-02. Irrigation - Hygienic concerns of irrigation water

Legal framework for greywater reuse (Germany)

- There are no mandatory regulations for greywater recycling in Germany
- The EU Directive for Bathing Water (2006/7/EC) has been taken as a basis to regulate the hygienic quality requirements for service water used for non-potable applications in buildings
- UV disinfection is recommended as a final treatment stage to ensure hygienic safety and high service water quality

EU Directive for Bathing Water (2006) Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality and repealing Directive 76/160/EEC. Jo L 64, 4.3.2006

REGULATORY FRAMEWORK

Guidelines and standards for indoor greywater reuse

	WHO/CEHA	Canadian Guidelines	British Standards	New South Wales, Australia	Berlin Standards for Greywater Reuse	EU Guidelines for Recreational Water
BOD5 (mg/l)	≤ 10	Median: ≤ 10; Maximum: ≤ 20		≤ 10	< 5	
TSS (mg/l)	≤ 10	Median: ≤ 10; Maximum: ≤ 20		≤ 10	minor	
Turbidity (NTU)	≤ 2	Median: ≤ 2; Maximum: ≤ 5	< 10			
Oxygen Saturation (%)					> 50%	
Transmission 254 nm (1cm)					> 60%	
Total coliforms (CFU/100 ml)			1000	≤ 10	< 100/ml als MPN	
Faecal coliforms (CFU/100 ml)	≤ 10			≤ 10	< 10/ml als MPN	
Intestinal Enterococci (I.E.) (CFU/100 ml)			100		< 10/ml als MPN (Faecal streptococci)	100 (guide); 200 (mandatory)
E. Coli (CFU/100 ml)		Maximum ≤ 200	250			250 (guide); 500 (mandatory)
Pseudomonas aeruginosa					< 1/ml als MPN	
Thermotolerant coliforms (CFU/100 ml)		Maximum ≤ 200				
Residual chlorine (mg/l)	≥ 0.5	≥ 0.5	< 2	≥ 0.5 - 2.0		
Uses	For toilet flushing and car washing	For toilet and urinal flushing	For WC flushing	For toilet flushing and washing machines	For toilet flushing and garden irrigation	
Source/Reference	Overview of Greywater Management: Health Considerations. World Health Organisation (WHO), Regional Office of the Eastern Mediterranean, Centre for Environmental Health Activities (CEHA), WHO, Geneva 2006.	Canadian Guidelines for Household Reclaimed Water for Use in Toilet and Urinal Flushing,. Health Canada. 2010.	British Standard BS 8525-1:2010 Greywater Systems - Part 1: Code of Practice. British Standards Institution (BSI) 2010.	New South Wales (NSW) Health Department, 2000.	Berlin Senate Department for Urban Development. 2003. Innovative Water Concepts: Service Water Use in Buildings. Berlin, 2003.	EU Directive for Bathing Water. 2006. Council Directive of 15 February 2006 concerning the management of bathing water quality and repealing Directive 76/160/EEC. Jo L 64, 4.3.2006.

Germany

In Germany, several organisations have developed a wide technical framework on sustainable urban water management (centralised & decentralised). These include:

- German Association for Water, Wastewater and Waste (**DWA**)
- German Institute for Standardisation (**DIN**)
- **DVGW** (Deutsche Verein des Gas- und Wasserfaches e.V.) is a recognized standardization body for the gas and water industry
- **BDZ (**Bildungs- und Demonstrationszentrum Dezentrale Infrastruktur e.V.)
- Association of Engineers for Water Management, Waste Management and Land Improvement (**BWK**)
- Association for Rainwater Harvesting and Water Utilisation (**fbr**)

DWA Set of Rules

The **DWA Set of Rules** is viewed in Germany as the general basis for planning, construction and operation of plants in water, wastewater and waste management, as well as in soil conservation.

It consists of Standards and Advisory Guidelines and is prepared by more than 1600 specialists, who are engaged in the association in an honorary capacity and work in more than 260 specialist committees and working groups.

New Alternative Sanitation Systems: DWA-A 272 NASS

DWA Working Paper **DWA-A 272E** "Principles for the planning and implementation of **New Alternative Sanitation Systems (NASS)**" has been published in June 2014 by the German Association for Water, Wastewater and Waste (DWA).

The release of the DWA-A 272 working paper is considered a big leap forward regarding the implementation of sustainable sanitation methods and technologies in Germany.

What are New Alternative Sanitation Systems (NASS)

- The concept of New Alternative Sanitation Systems (NASS) is to close the water and material cycles as far as possible to recycle the valuable material present in wastewater (water, carbon, nitrogen, phosphorus, …)
- NASS is based on the separate collection of household material flows directly at the generation site or point of origin
- This can be achieved by separate drainage, treatment and subsequent reuse of the different material flows
- It defines several flow system groups such as the **2-material flow system** (greywater, blackwater) and **3-material flow** system (greywater, yellow water, brown water)

NASS considerations

Ecological aspects:
water quality & groundwater protection requirements, resource and environmental efficiency

Economical aspects:
costs, funding programmes, economic efficiency, global market

Social aspects:
environmental and health awareness, attitude to water conservation, need for security, user comfort, cultural diversity

Organizational & institutional aspects:
organization structure, compulsory connection & usage, NASS product classification

Greywater recycling

- **DWA-Topics** (2019) Non-Potable Water Reuse - Development, Technologies and International Framework Conditions for Agricultural, Urban and Industrial Uses. DWA It focuses on the reuse of reclaimed water produced from municipal wastewater by centralised or decentralised treatment facilities
- **fbr Hinweisblatt H 201** (2017) Hinweise zur Auslegung von Anlagen zur Behandlung und Nutzung von Grauwasser und Grauwasserteilströmen. Association for Rainwater Harvesting and Water Utilisation (fbr). Identical with DWA-M 277E
- Guideline **DWA-M 277E** (2017) Information on design of systems for the treatment and reuse of greywater and separated greywater flows. DWA
- **VDI 2010** (2013) Service water management for buildings and estates. VDI-Gesellschaft Bauen und Gebäudetechnik (GBG). Verein Deutscher Ingenieure (The Association of German Engineers).
- Innovative Water Concepts – Service water utilisation in Buildings (2007). Berlin Senate Department for Urban Development https://www.stadtentwicklung.berlin.de/bauen/oekologisches_bauen/download/modellvorhaben/betriebswasser_englisch2007.pdf
- Service water use in buildings (1995) - Evaluation of the Berlin model project. Berlin Senate Department for Urban Development

Rainwater Management

Standard **DWA-A 138E** (2005): Planning, Construction and Operation of Facilities for the Percolation of Precipitation Water.

- Is regarded as state of the art and has been used for many years in new developments and existing buildings
- Gives advice on the planning, construction and operation of rainwater infiltration plants such as surface infiltration, swales, infiltration trenches, as well as combined systems such as swale-trench infiltration

fbr-Hinweisblatt H 101 (2016) Kombination der Regenwassernutzung mit der Regenwasserversickerung (Combination of rainwater harvesting with rainwater infiltration). Association for Rainwater Harvesting and Water Utilisation (fbr)

Standard **DWA-A 102** (Blueprint) (2016): Principles on the management and treatment of rainwater flows for discharge into surface waters (Grundsätze zur Bewirtschaftung und Behandlung von Regenwetterabflüssen zur Einleitung in Oberflächengewässer).

Rainwater Management (2)

- **DIN 1989-1** (2002): Rainwater harvesting systems - Part 1: Planning, installation, operation and maintenance. Beuth Verlag
- **DIN 1989-2** (2004): Rainwater harvesting systems - Part 2: Filters. Beuth Verlag
- **DIN 1989-3** (2003): Rainwater harvesting systems - Part 3: Collection tanks for rainwater. Beuth Verlag
- **DIN 1989-4** (2005): Rainwater harvesting systems - Part 4: Components for control and supplemental supply. Beuth Verlag

Green roofs

FLL Green Roof Guidelines* – 2018
Guidelines for the planning, construction and maintenance of green roofs
FLL (Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau e.V.)

In Germany, the German Landscape Research, Development and Construction Society (**FLL**) provides guidelines and standards for design, planning, construction and maintenance of green roofs in Europe. These include building techniques, loading capacity, wind uplift protection, fire protection, thermal and acoustic insulation, waterproofing material and installation, up-stands, slope and drainage as well as planting and landscape architecture requirements.

*https://shop.fll.de/de/english-publications/green-roof-guidelines-2018-download.html

Energy from wastewater

- **fbr- Band 16** (2013) Energetische Nutzung von Regenwasser (energetic use of rainwater). Association for Rainwater Harvesting and Water Utilisation (fbr)

- Advisory Guideline **DWA-M 114E** (2009): Energy from Wastewater – Thermal and Potential Energy. DWA.