Interreg Baltic Sea Region

Co-funded by the European Union

SUSTAINABLE WATERS WaterMan

Overview of the pilot status

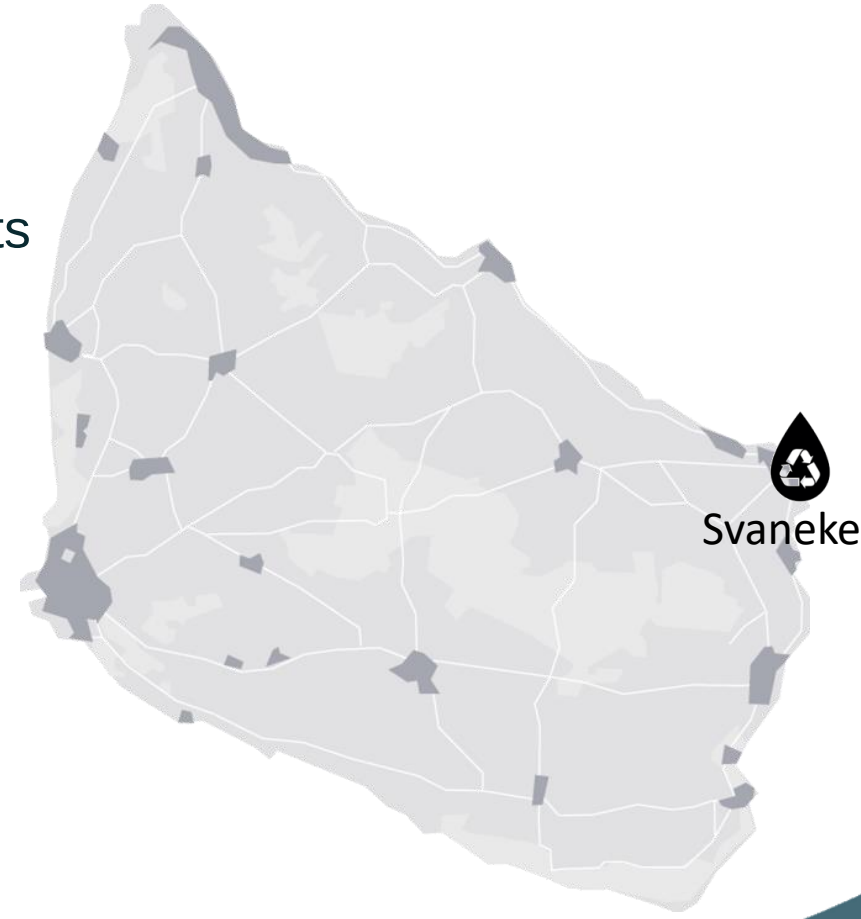
Recycling treated wastewater for agricultural use

Bornholm's Energy & Utility Co. A/S

30 April 2025

LOCAL WATER MANAGEMENT SITUATION

- Heavy rainfall – overflow of sewage system and nutrient outflow to the Baltic sea
- Draughts – impacting the agriculture and groundwater formation
- Tourist season puts a pressure on the wastewater treatment plants and drinking water supply
- Challenges with drinking water quality – organic micropollutants



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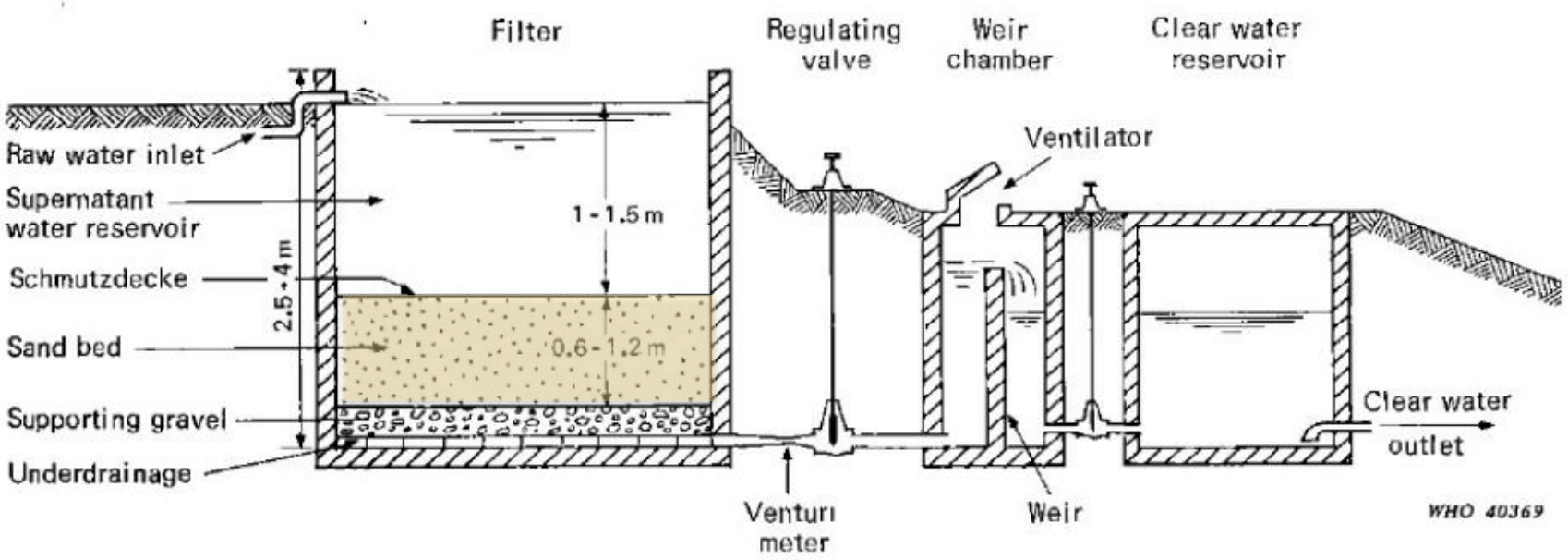
OUR TECHNOLOGY: SLOW SAND FILTER AS TERTIARY TREATMENT OF WASTEWATER

Slow sand filter (SSF)



- This is a schematic from the 1974 World Health Organization (WHO) “Slow Sand Filtration” design manual (Huisman & Wood, 1974. pg 18).

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MONITORING OF SOURCE WATER

- Regular monitoring of WWTP-effluent, flow proportional 24h

eurofins

ilac-MRA DANAK TEST Reg.No. 168

Eurofins Miljø A/S
Ladelundvej 85
6600 Vejen
Danmark
Telefon: 7022 4266
CVR/VAT: DK-2884 8196

Bornholms Spildevand A/S
Skansevej 2
3700 Rønne
Att.: Torben Jørgensen

Rapportnr.: AR-23-CA-23067834-01
Batchnr.: EUDKVE-23067834
Kundenr.: CA0017497
Modt. dato: 10.08.2023

Analyserapport

Prøvested: Svaneke Renseanlæg - u020217 / 14050003
Prøvetype: Spildevand
Prøveudtagning: 12.07.2023 til 13.07.2023
Prøvetager: Rekvirenten PMS
Analyseperiode: 10.08.2023 - 22.08.2023

Kunde Ref.: Svaneke rens ud
Prøvemærke: Udløb 004006960003637751

Lab prøvenr:	835-2020-80893466	Enhed	Kravværdier Min.	Kravværdier Max.	DL.	Metode	Urel (%)
Konduktivitet (Ledningsevne)	1000	µS/cm			5	DS/EN 27888:2003	15
Uorganiske forbindelser							
Total Nitrogen	6.5	mg/l			0.05	DS EN ISO 11905-1:1998,ISO 15923-1:2013 mod.	15
Total Phosphor	1.6	mg/l			0.01	DS/EN ISO 6878:2004 part 7 + ISO 15923-1:2013	15
Organiske samleparametre							
BI5 (med ATU)	2.4	mg/l			0.5	DS/EN 1899-1	20
COD, kemisk iltforbrug	32	mg/l			5	ISO 15705	15
Oplysninger fra rekvirent							
Prøvetagningsmetode	Mgd.prop.					*	
Prøvetagningsudstyr	Eget					*	
Vandmængde	1737	m³/døgn				*	
Vandtemp. i dunk v. nedtagning	3.8	°C				*	
Nedbør	10	mm				*	
Nedbør, døgnet før prøvetagning	10	mm				*	

Batchkommentar:

Analyser er udført på prøve der er modtaget frosne.

- One E. Coli/ Total coliform measurement of WWTP-effluent, grab sample in May
  - E. Coli: approx. 27.000 CFU/100 ml
  - Total Coliform: approx. 271.700 CFU/100 ml

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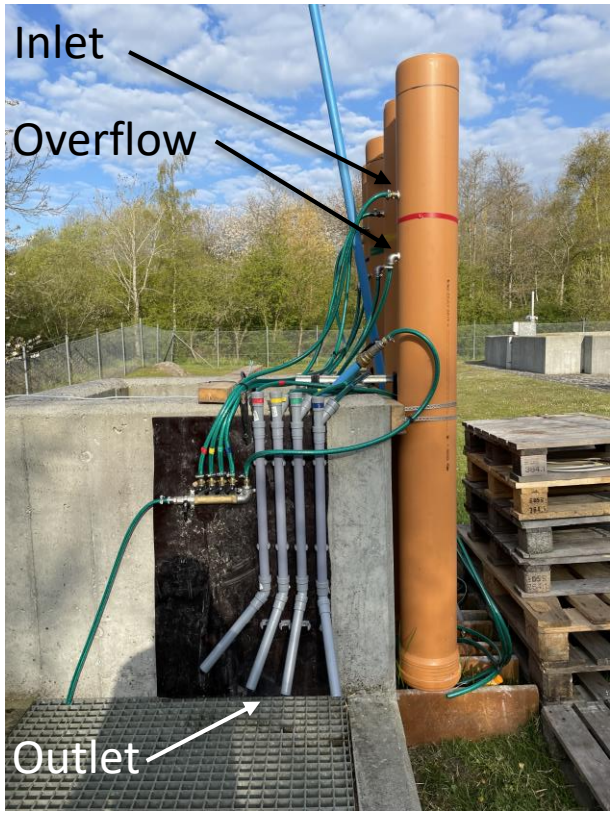
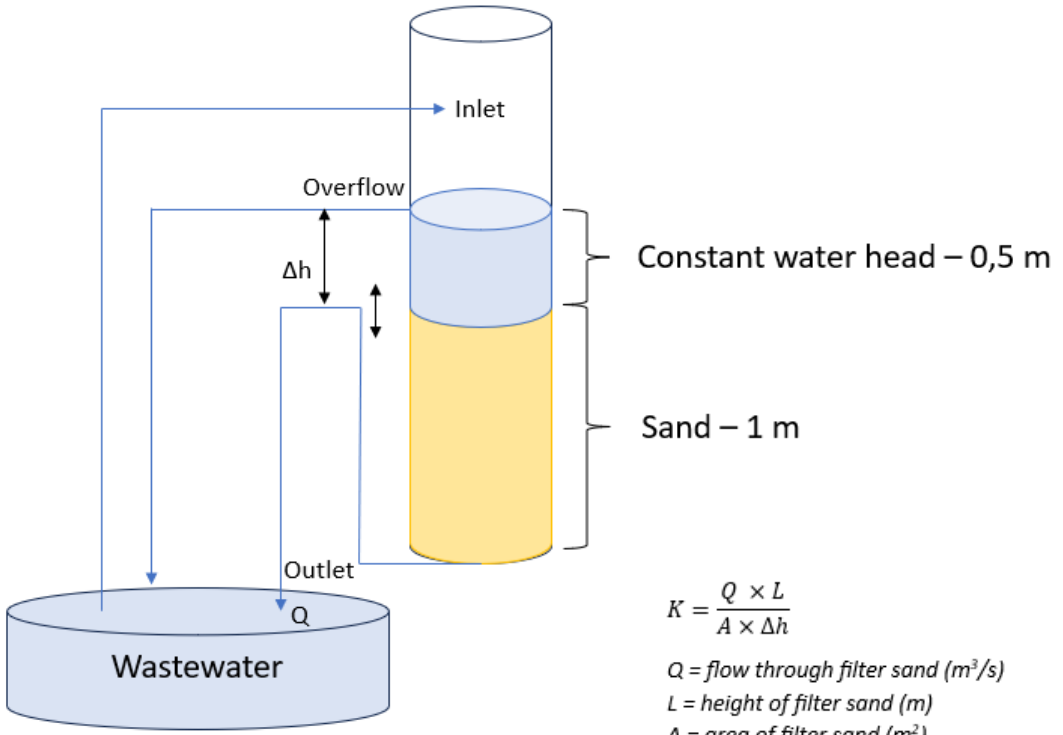
INITIAL TESTS

- Testing the hydraulic capacity of different sands





$$K = \frac{Q \times L}{A \times \Delta h}$$

Q = flow through filter sand (m^3/s)
L = height of filter sand (m)
A = area of filter sand (m^2)
Δh = distance between height of outlet and overflow (m)

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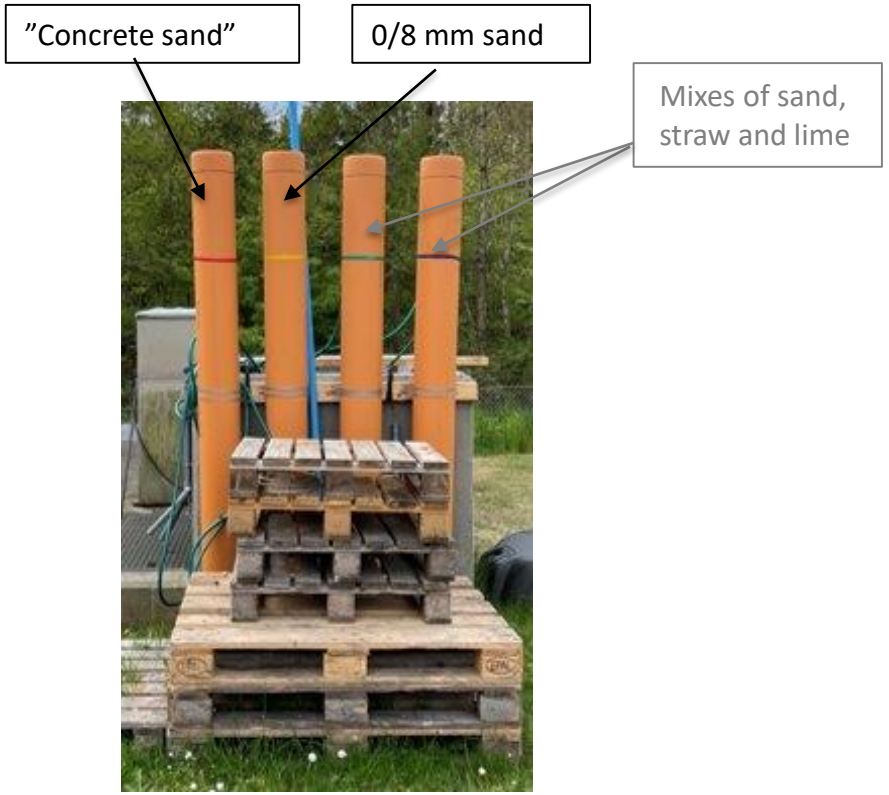
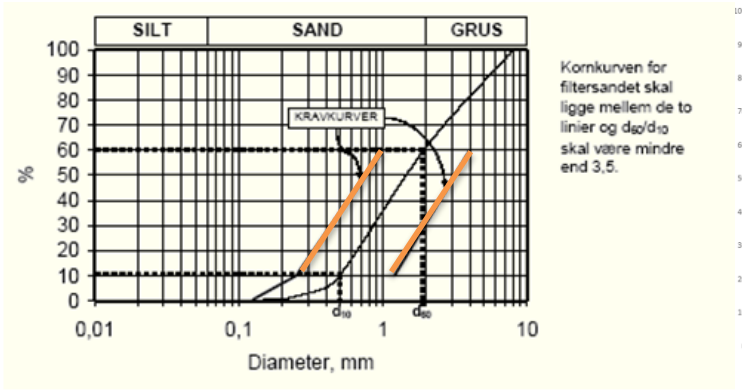
INITIAL TESTS

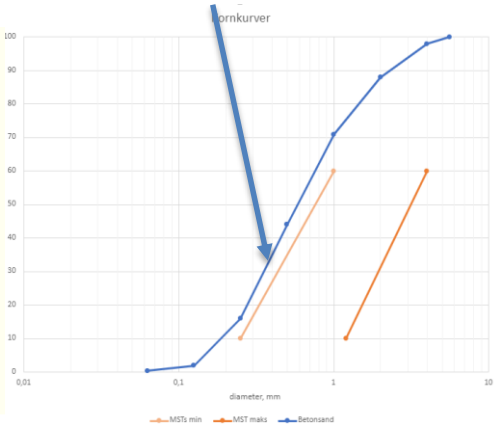
- Hydraulic capacity of sand



- Sand for test columns selected on basis of the Danish Environmental Protection Agency’s recommended grain size distribution profile for biological sand filters.

Blue line = Concrete sand





- Sand from local gravel mine on Bornholm. Sand is processed (separated by particle size and washed)

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INITIAL TESTS - OBSERVATIONS

- Observations hydraulic capacity – the Schmutzdecke

- Reduces the flow significantly
- Needs to be removed from time to time, due to it acting as plug reducing the flow
- Schmutzdecke is removed by scraping top layer of sand after draining the filter

INITIAL TESTS - OBSERVATIONS

- The microbial biodegradation is taking place mostly in the Schmutzdecke
- We need the Schmutzdecke!
- Compromise between water quality and quantity

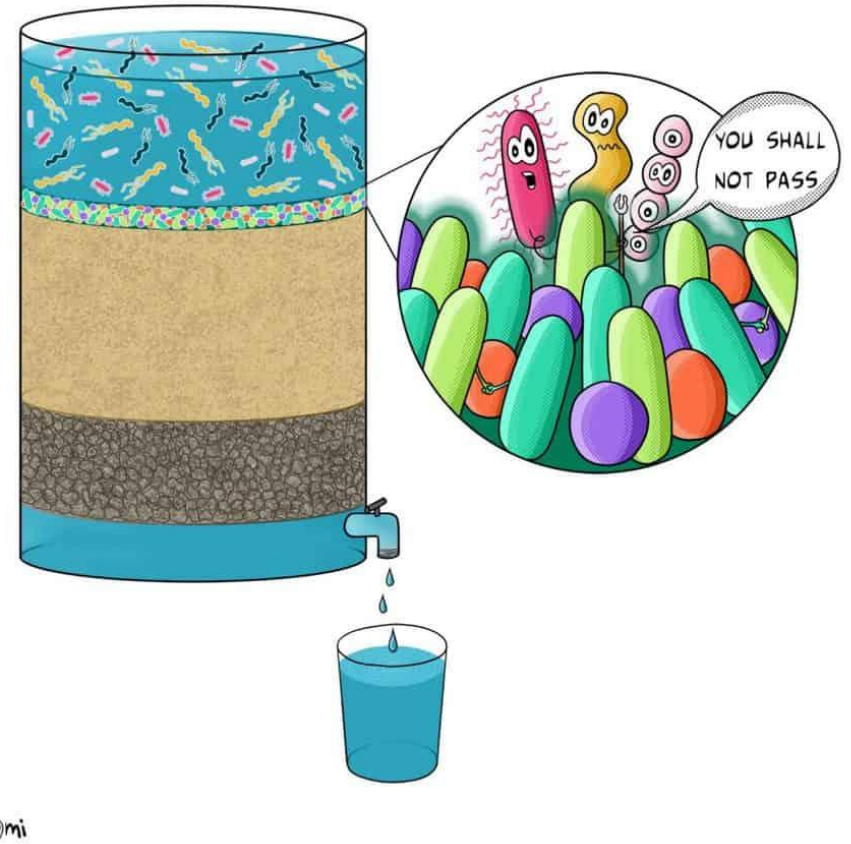

image source: https://sarahs-world.blog/microbes-clean-our-drinking-water/

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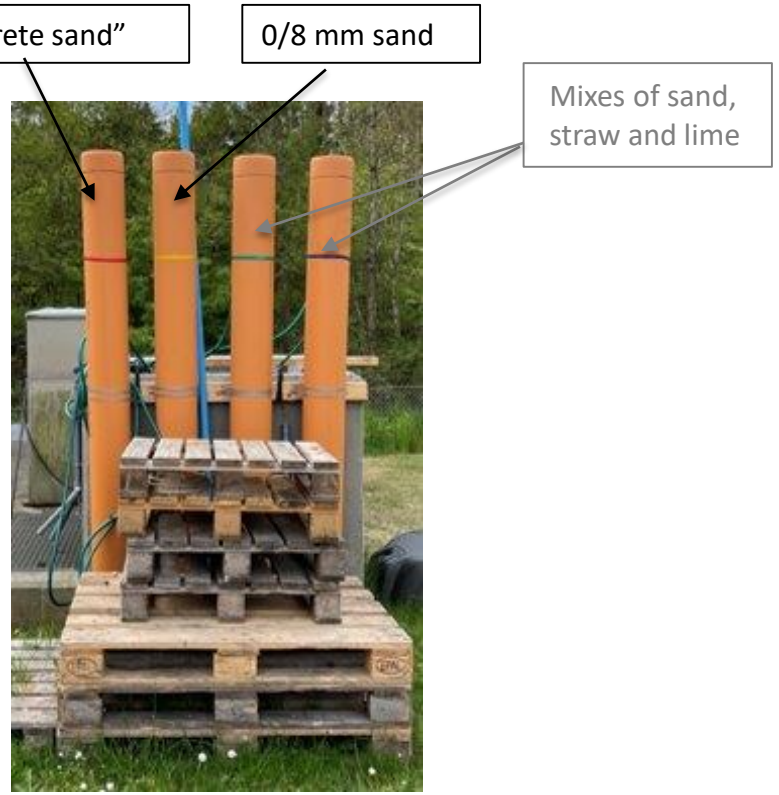
INITIAL TESTS - PRELIMINARY REULTS – E. COLI

Concrete sand to be used for the feasibility study



E.Coli

	Feed (CFU/100ml)	Concrete sand (CFU/100ml)	0/8mm sand (CFU/100ml)
23-10-2023	142900	100	*No flow*
24-10-2023	19500	5400	500

Schmutzdecke stirred the day before and Δh adjusted

Coliforme

	Feed (CFU/100ml)	Concrete sand (CFU/100ml)	0/8mm sand (CFU/100ml)
23-10-2023	1000000	4000	*No flow*
24-10-2023	1000000	289600	26900

Need to work further on sampling and analysis procedures to get good quality results

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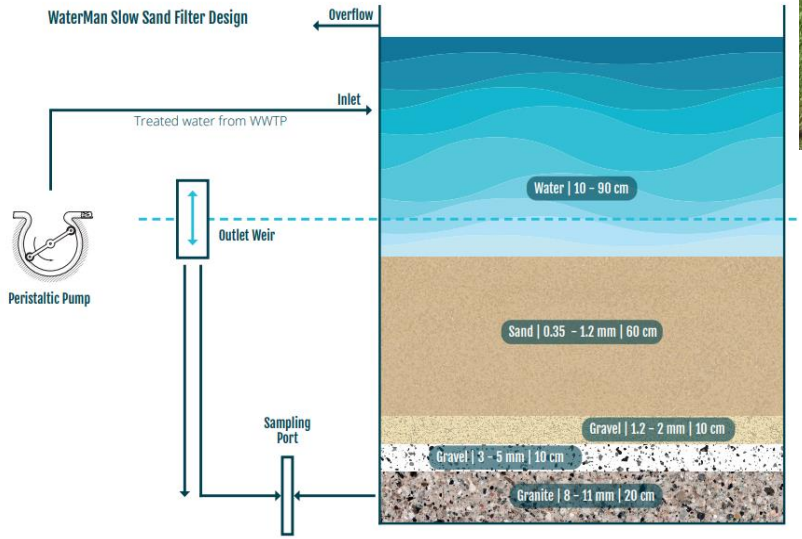
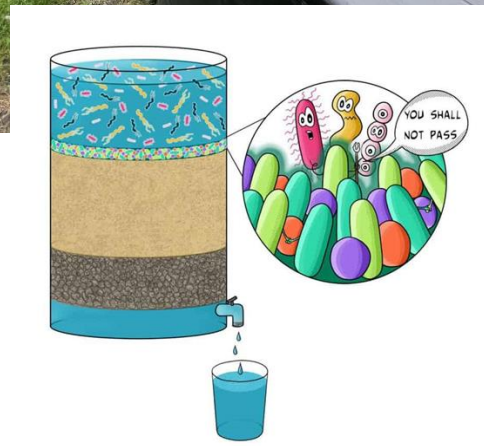
PILOT – SSF (Slow Sand Filter)





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SSF STATUS – operation & results

- Results:

			A	B	C	D	Feed		Filtrate	
Date	Pump C value	Effluent flow (l/h)	Sand-Top (cm)	Water level-Top(cm)	Weir chamber-Top (cm)	**dH Driving pressure**	E.Coli CFU/100 ml	Total Coliforms CFU/100 ml	E.Coli CFU/100 ml	Total Coliforms CFU/100 ml
21-10-2024	300	260	95	33	47	14				
22-10-2024	345	285	95	11	47	36				
24-10-2024	345	120	95	11	47	36				
25-10-2024	345	271	95	26	**82**	56				
28-10-2024	345	225	95	11	**82**	71	17000	795400	370	10000
30-10-2024	345	171	95	11	**82**	71	34000	1000000	972	10000
31-10-2024	345	225	95	17	**82**	65				

- Operation:
  - Unstable flow (changed piping system)
  - Filter overflow
    - Cleaning the sand (harrowing)
  - Fast decline of the outflow
  - Potential decrease of biological activity during winter

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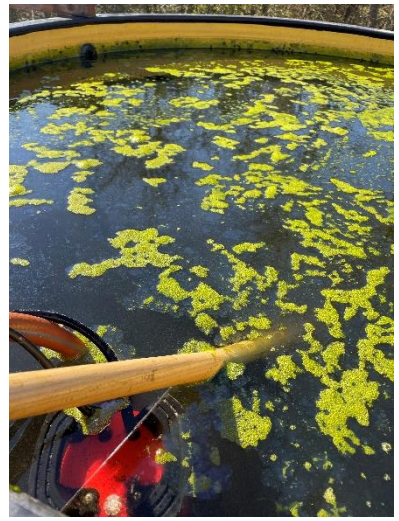
Pilot unit - Slow Sand Filter

- **Operations**
  - Reduction in coliforms and nutrients.
  - High maintenance due to clogging. Reduced water flow.
  - Algae formation, but recently stabilized, perhaps because of a biocide. Water became clear. But still with reduced flow.
- **Sampling/monitoring program (1X week)**
  - Sampling coliforms
  - Monitoring water level and flow
  - Monitoring water temperature
  - *Further analysis to be made*:
    - Medicine & PFAS
    - TSS (inlet and effluent)
- **Cleaning program**
  - For a period (1x week) we “scratched” the top layer with a rake and pumped water out, due to clogging. After cleaning, coliforms level increases, so as water flow, but back to normal in 2 days.
  - At the moment (12/05/25), we are stressing the system (no cleaning) and conduct tests.
  - After further analysis, we intend to replace the sand top layer.






Greenhouse

Plant (spinach) irrigation with water (polished) derived from the WaterMan slow sand filter, and water (nutrient loaded) from the Symsites project. Two separate feeding lines with drip irrigation into capillary boxes, to avoid spilling.

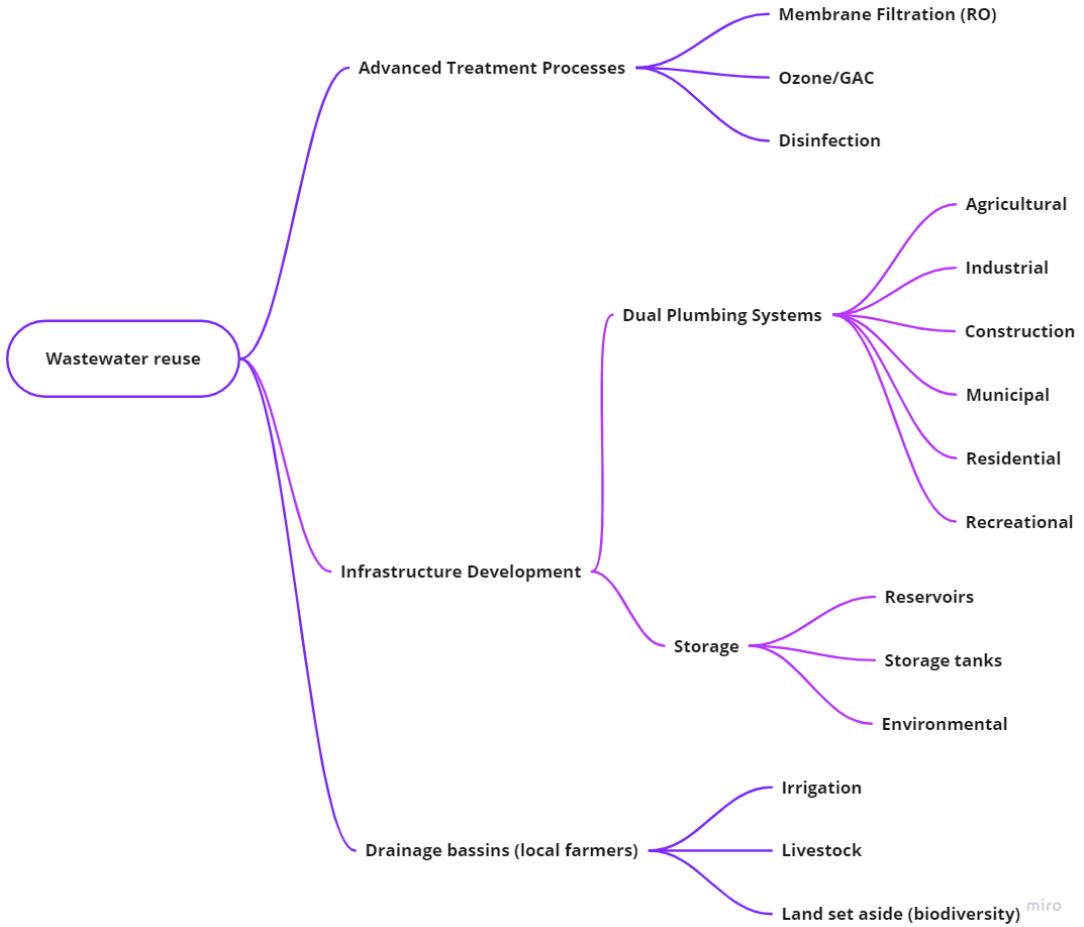
Key Points

- **Positive Impacts of Interaction:**
  - Enhances **awareness** and **acceptance** of innovative practices among potential users.
  - Provides valuable **exposure to the WaterMan project** among farmers.
- **Joint Efforts with Symsites Project:**
  - The initiative was established as a **collaborative task** alongside the ongoing Symsites project.

USER GROUPS FOR TECHNICAL WATER

- Envisaged:
  - Local farmers
    - Nearby (pumping; gravity)
    - Distant (pumping; dual plumbing systems)

- Potential:
  - Industry (process water)
    - Cleaning, manufacturing, aquaculture…
  - Municipal (irrigation)
  - Residential (irrigation; toilet flushing)
  - Recreational (golf courses; wetlands (nature parks))
  - Storage (reservoirs; tanks; wetland restoration)



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Workshop with potential users

Key Points

- Information on possibilities and need for reuse of treated wastewater
- Promote stakeholder & consumer acceptance for water reuse

Workshop

- Agriculture irrigation
- Water storage/retention
- Stakeholder engagement
- Potential users
- Discussion on concerns & requirements
- Future water demand; new crops
- Supply options

Local strategy

- Supplement to BEOFs internal strategy ”The future wastewater system” and “Wastewater as a resource”.

Baltic Sea Region Toolbox

- Results presentation

WATER USAGE – EVALUATION METHODS

Multi-step evaluation aproach

1 - Water Quality Monitoring

- Physical Parameters
- Chemical Analysis
- Microbial Testing

2 - Agronomic Impact Studies

- Soil Testing
- Crop Health and Yield Assessment

3 - Irrigation Efficiency Evaluation (future)

- Drip and Surface Irrigation Performance
- Application Consistency Tests (nutrient deficiency areas)

4 - Long-Term Environmental Monitoring (future)

- Groundwater Testing
- Runoff Analysis

5 - Economic and Social Impact Assessment (future)

- Economic viability (potential yield improvements or savings from water reuse)
- Conduct surveys or interviews with end-users (farmers) to gauge satisfaction, adoption rates, and any challenges faced in using the treated water

Scenarios: greenhouse with growbeds, or farmland (open for discussion with lead partner)

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Thank you

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Interreg Baltic Sea Region

Co-funded by the European Union

Access the „BSR Water Recycling Toolbox" here.
https://www.eurobalt.org/waterrecyclingtoolbox/

SUSTAINABLE WATERS
WaterMan

The „BSR Water Recycling Toolbox" was elaborated as part of the project "WaterMan - Promoting water reuse in the Baltic Sea Region through capacity building at local level", The project is co-financed by the European Union (European Regional Development Fund) and implemented within the Interreg Baltic Sea Region Programme. More information:

eurobalt.org/WaterRecyclingToolbox
interreg-baltic.eu/project/waterman

WaterMan promotes a region-specific approach to water recycling, which intends to use the alternation of too much and too little water that has become typical in the Baltic Sea Region to make the local water supply more resilient, and supports municipalities & water companies in adapting their strategies.