Water Reuse: The Future is NOW

About Me

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- B.Sc. in Hydrology, TSU
- 10+ years NSF Waco Test Facility
- Outdoor enthusiast & environmentalist
- Passionate about water scarcity

*The materials being presented represent their own opinions, and do NOT reflect the opinions of NOWRA.

A Global Crisis: **Water Scarcity**

Drivers of Water Scarcity

Consumption patterns

Irrigation needs

Climate dynamics

Population growth

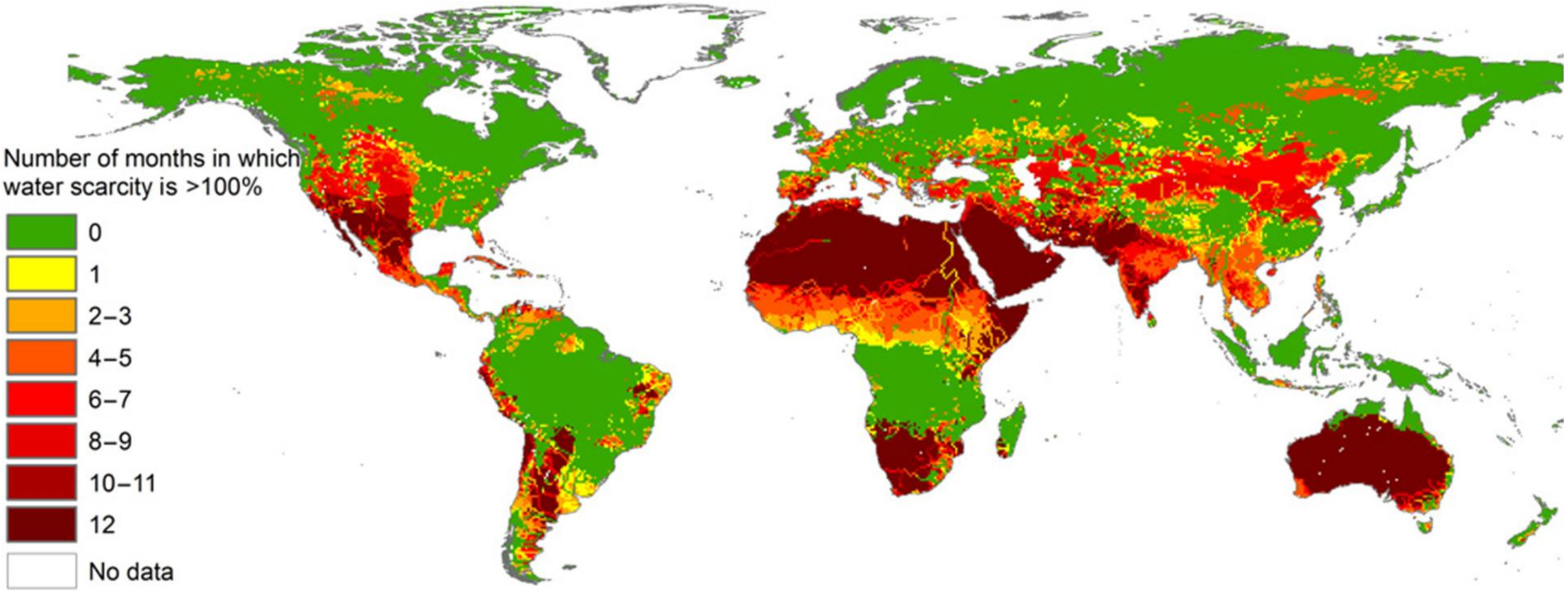
Global water usage has been increasing ***twice*** the rate of population growth.

Source: United Nation

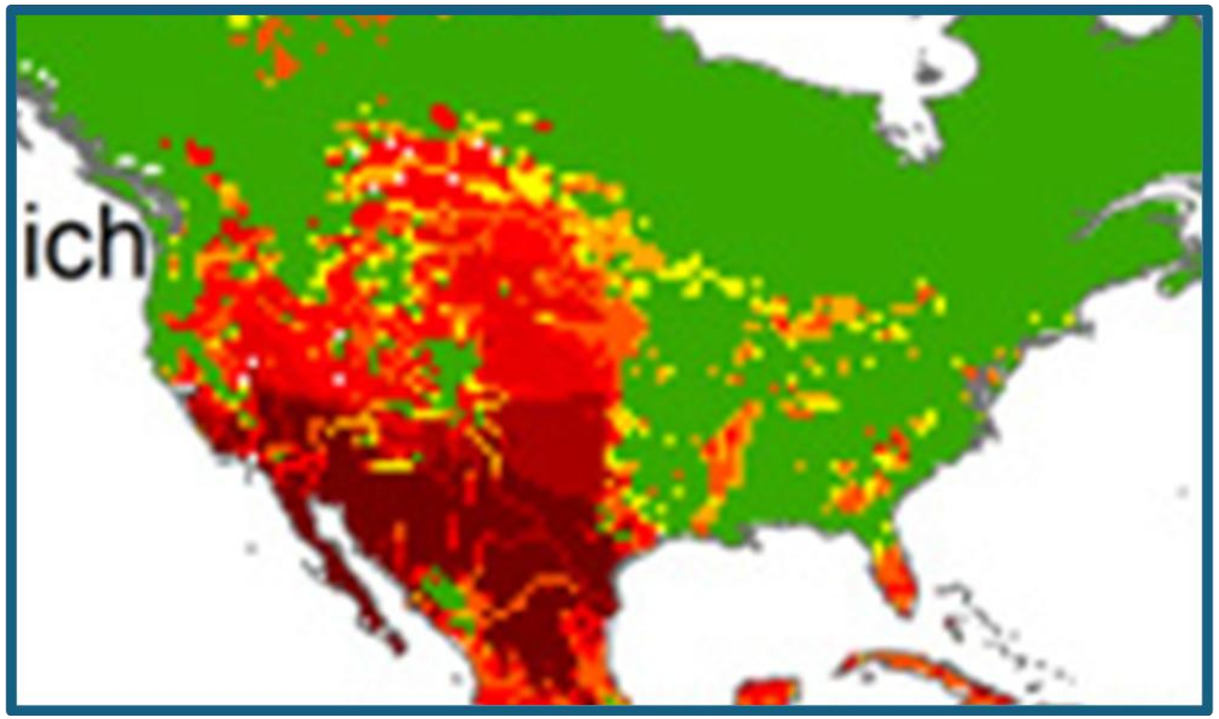
4.0 BILLION

people experience *severe water scarcity*
at least one month out of the year.

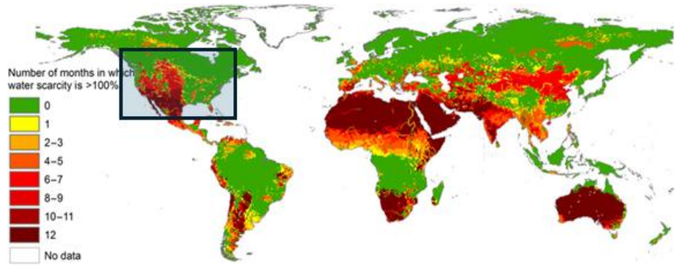
A Global Crisis



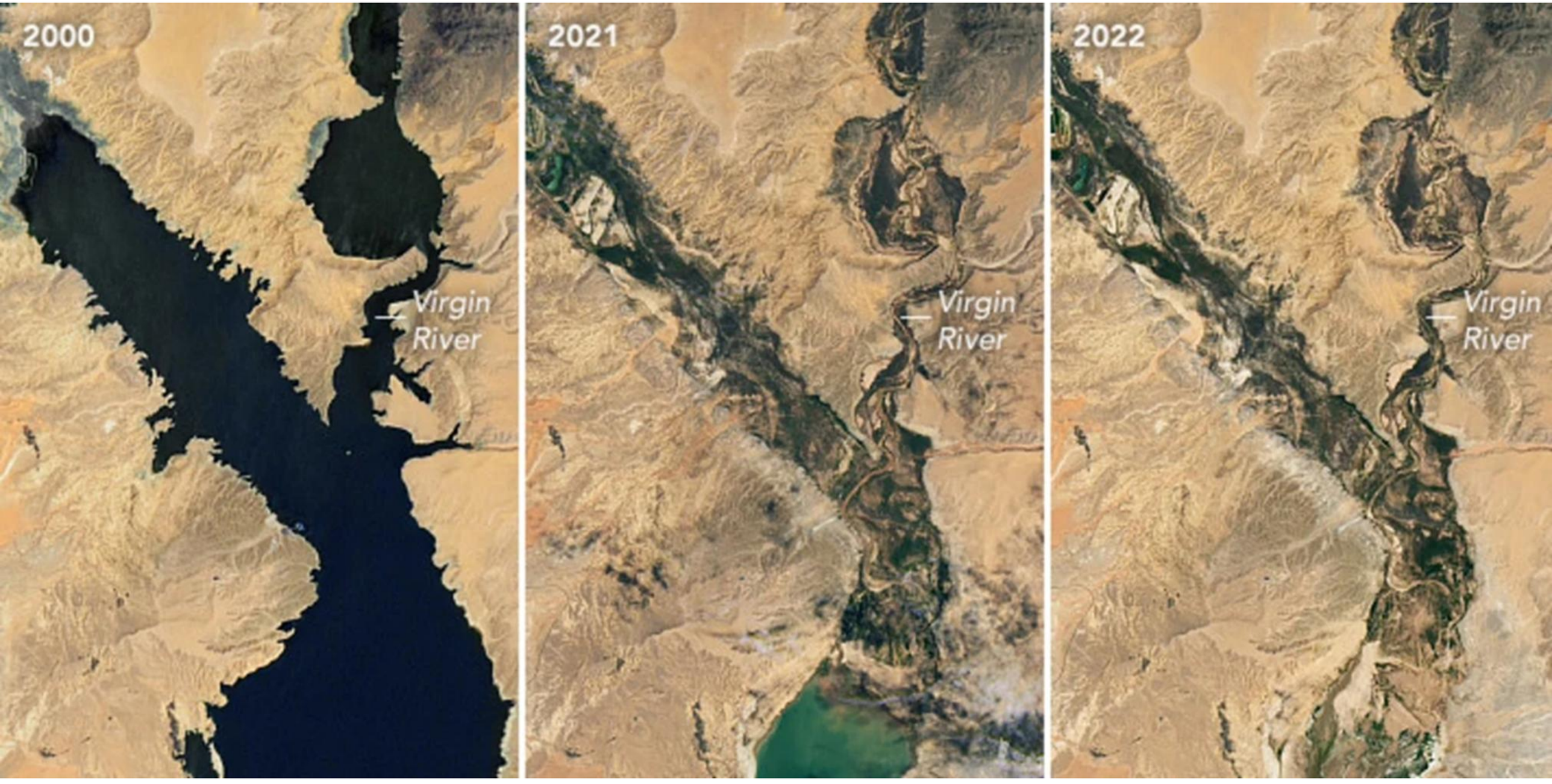
A National Perspective



- Western U.S. faces 6 months of water shortage



Drought Lake Mead


2000
Virgin River
2021
Virgin River
2022
Virgin River

A National Perspective

US Average Household Water Usage

300
gallons
per day

70%
indoors

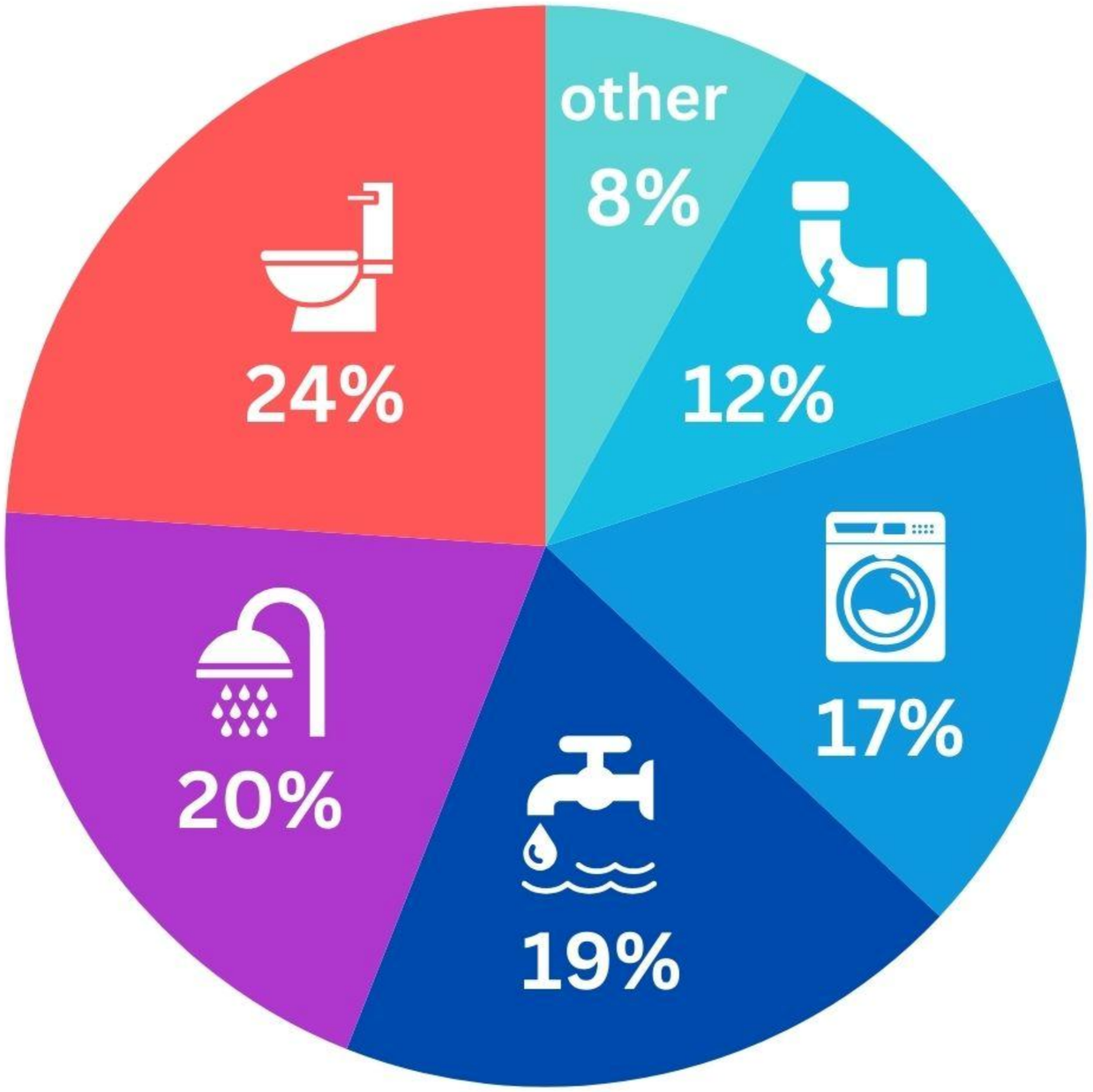
30%
outdoors
(irrigation)

109,500
gallons
per year

Indoor Use

How much water do we use?

- **210 GPD**
- **50 GPD for toilet**



Source: Water Research Foundation, Residential End Uses of Water, Version 2. 2016

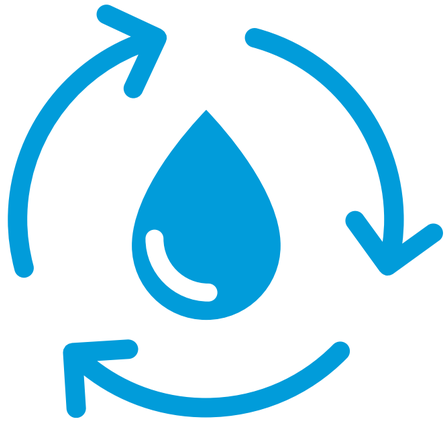
A Sustainable Solution: **One Place Water**

One Place Water

Integration

Collection

Treatment

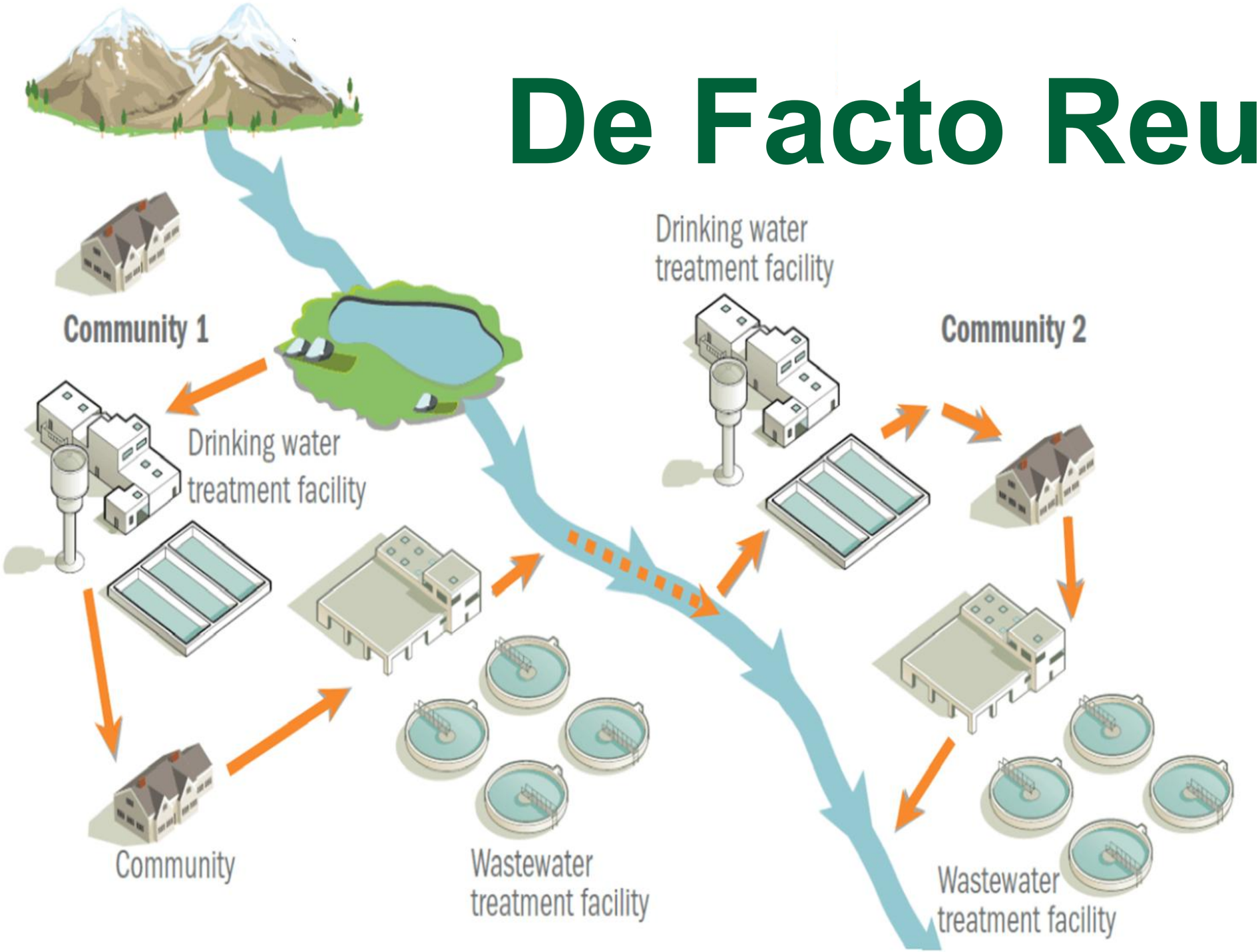


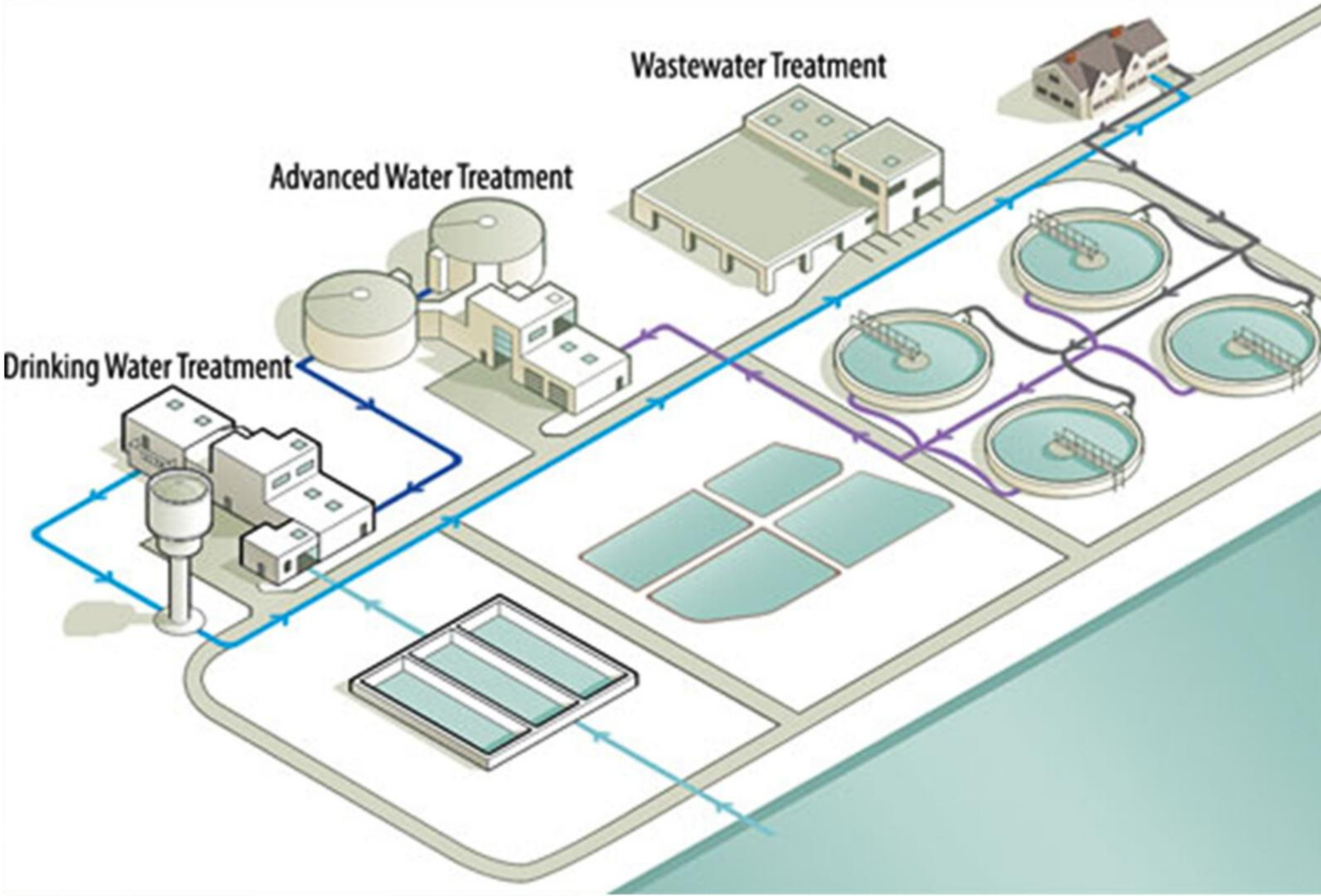
Reuse

Water Reuse

- Reclaimed water
- Non-potable water
- Water recycling

De Facto Reuse




Wastewater Treatment
Advanced Water Treatment
Drinking Water Treatment

Reuse Hurdles

Centralized/Municipal

- Costly
- Often not available

Reuse Hurdles

Onsite/Decentralized

Public Awareness/ Acceptance

Cost of Installation

Regulatory Guidance/ Permitting

Public Awareness/Acceptance

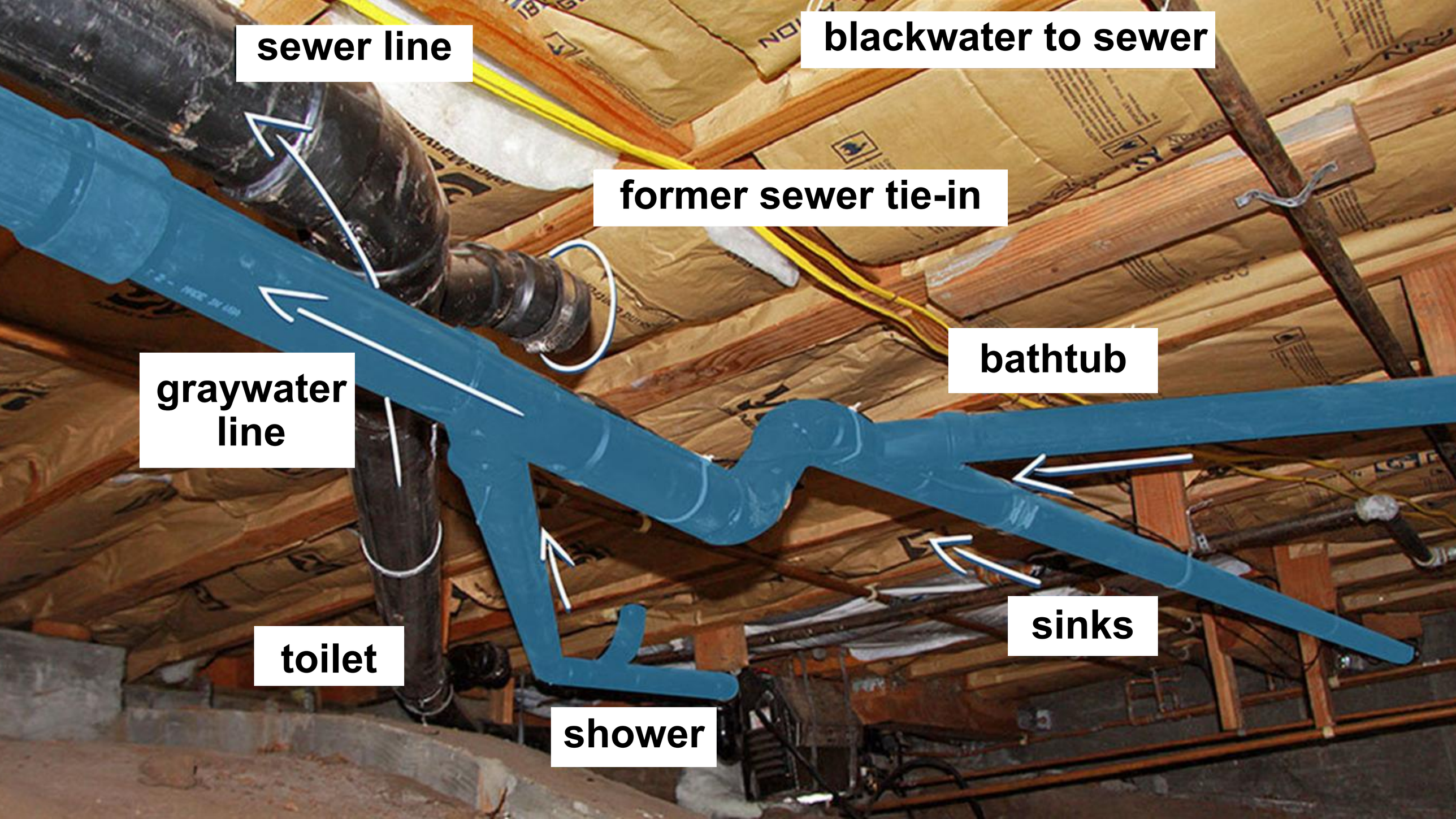
- Inherent health risk
  - Contact with non-potable reuse water
  - Cross contamination

User confidence and
workforce training are key
to support water reuse efforts.

Source: The National Blue Ribbon Commission (NBRC)

Cost

- Installation
- maintenance
- Dual plumbing required (indoor)

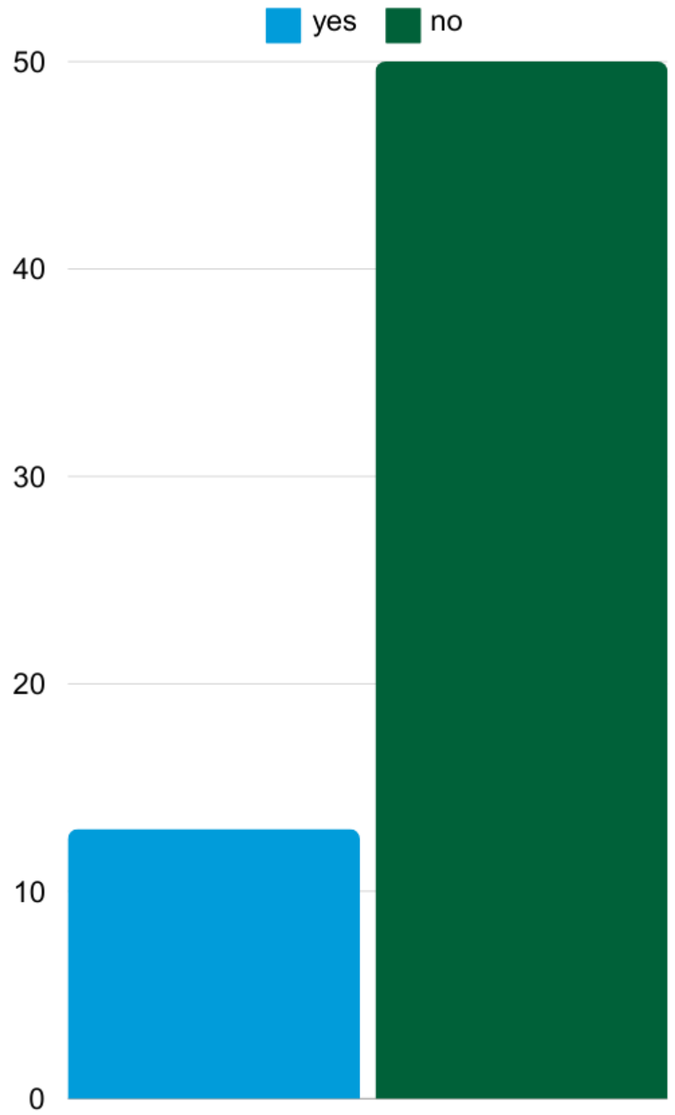

sewer line
blackwater to sewer
former sewer tie-in
graywater line
bathtub
toilet
shower
sinks

Regulatory Guidance/Permitting

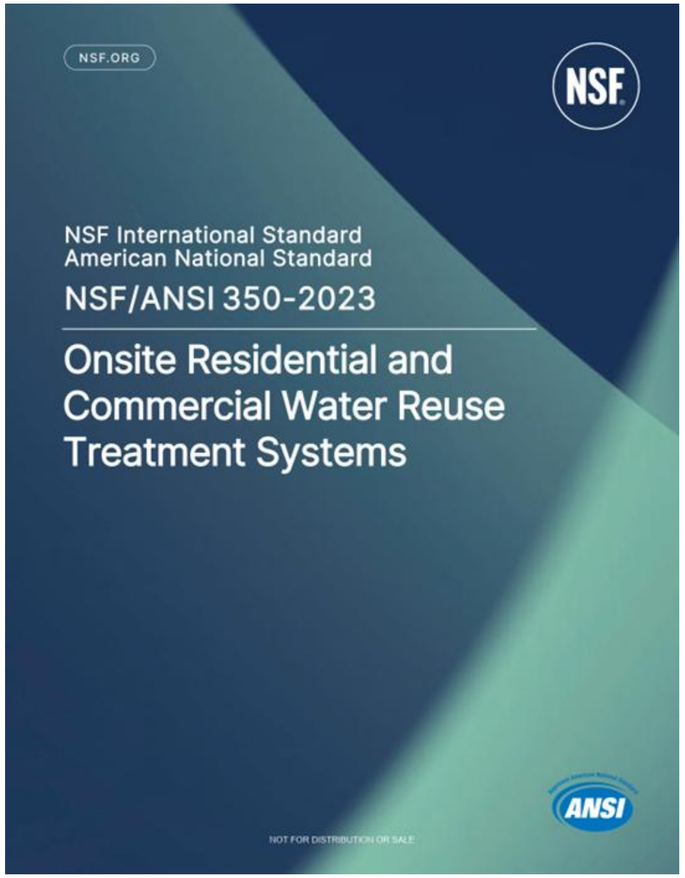
- Key obstacles:
  - ***Lack*** of national standards and regulatory guidelines
  - ***Need*** for streamlined permitting process

- **13** states have guidelines for reuse:

  CA, CO, FL, GA, HI, MN, NM, OH, OK, OR, TX, WI

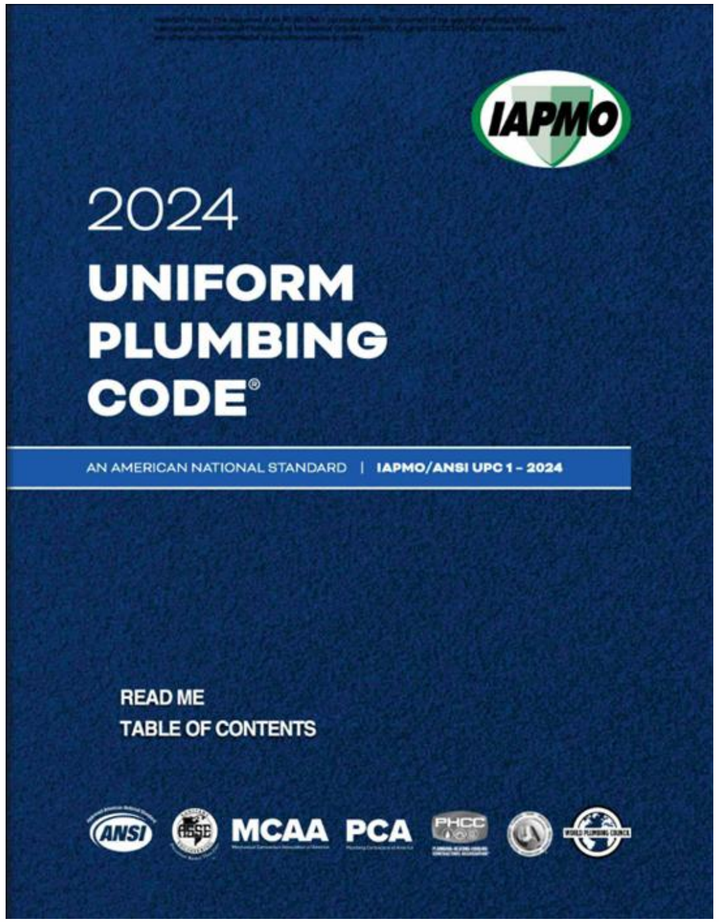


National Sanitation Foundation



- July 2011, new American National Standard for on-site wastewater reuse treatment
- NSF/ASI 350

NSF/ANSI 350



- In state regulatory codes for:
  - CA, CO, FL, OH, and OR
- Uniform Plumbing Code
- International Plumbing Code

An American National Standard: **NSF/ANSI 350**

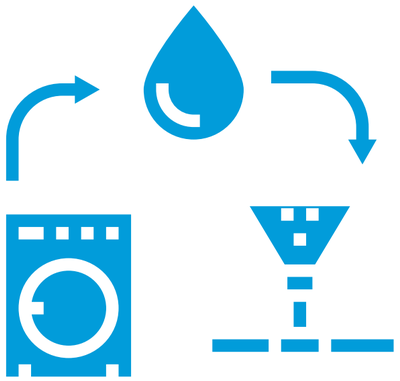
NSF/ANSI 350

- ***Define*** minimum
  - Material
  - Design
  - Construction
  - Performance requirements

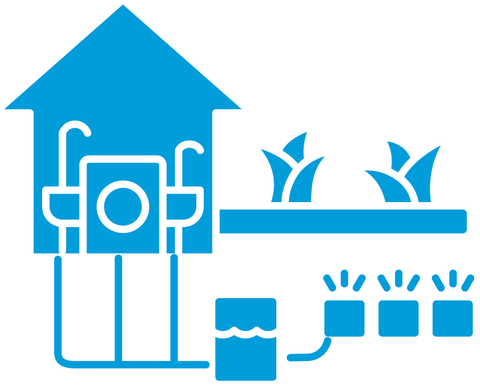
Intended for the growing demand of onsite non-potable water reuse.

Water Reuse Treatment

Categories



Graywater



Residential Wastewater

Commercial

Certification Testing Procedure for Residential Wastewater

Certification Testing Procedure

3
samples per week

7.5 weeks
stress events

12
parameters sampled

26 weeks
design loading

Designed Loading

- System dosed with 100% of its' rated hydraulic capacity daily

Stress Events

- 4 stress events
- separated by a week of designed loading

Wash-Day

Working Parent

Power/Equipment Failure

Vacation

Influent Wastewater Requirement

- Maintain 30-day average concentrations

BOD_5
100 mg/L - 300 mg/L

TSS
100 mg/L - 350 mg/L

Effluent Requirements

Parameter	Test Average	Single Sample Maximum
$CBOD_5$	10	25
TSS	10	30
Turbidity	5	10
*E. coli	14	240

*Average calculated as Geometric Mean

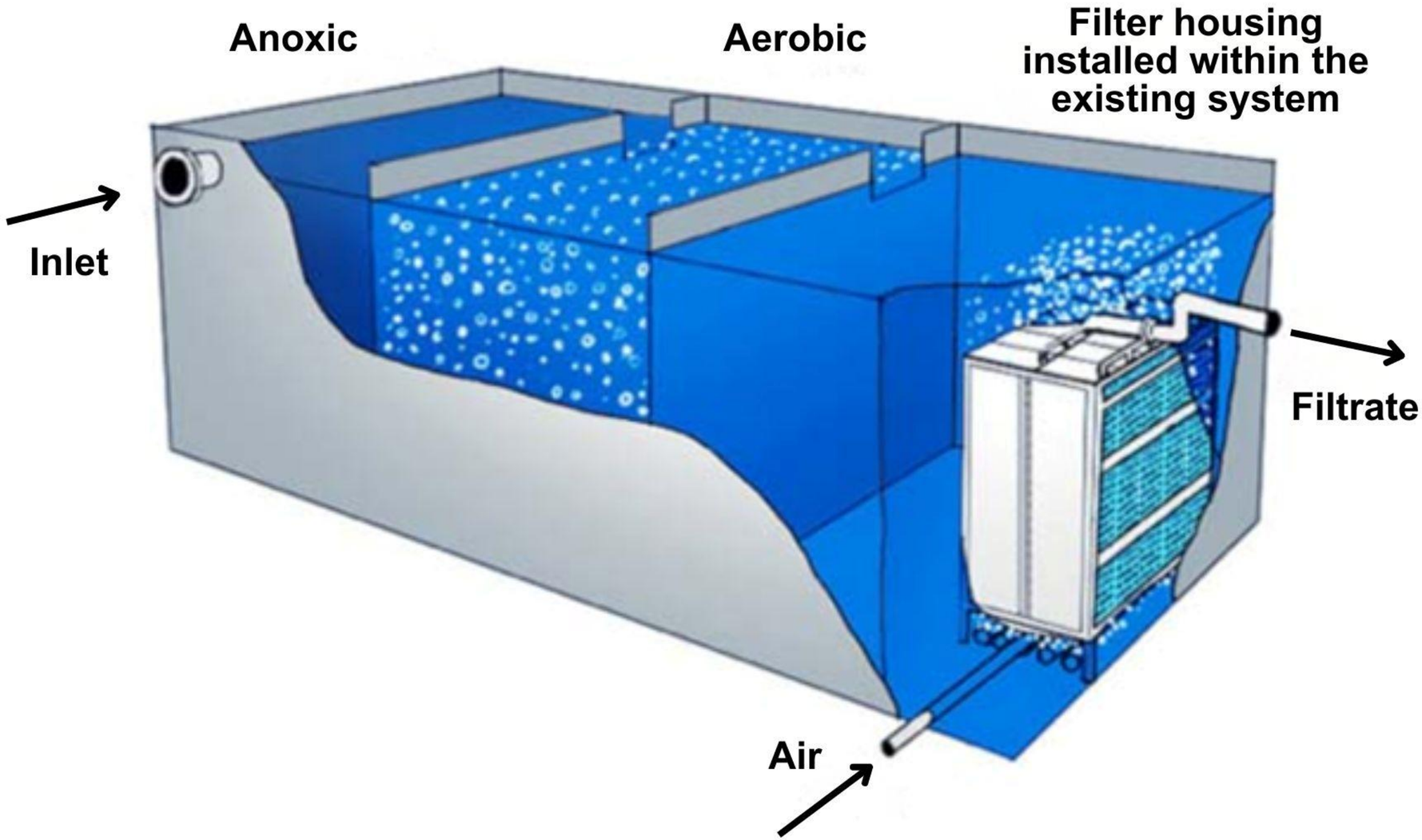
Onsite Wastewater Treatment: **Non-Potable Reuse**

Onsite Reuse Technology

- Membrane Bioreactor (MBR)

PROS	CONS
Exceptional effluent quality	Membrane fouling
Smaller footprint	Continuous monitoring
May not require UV disinfectant	High cost initially and with lifetime O&M

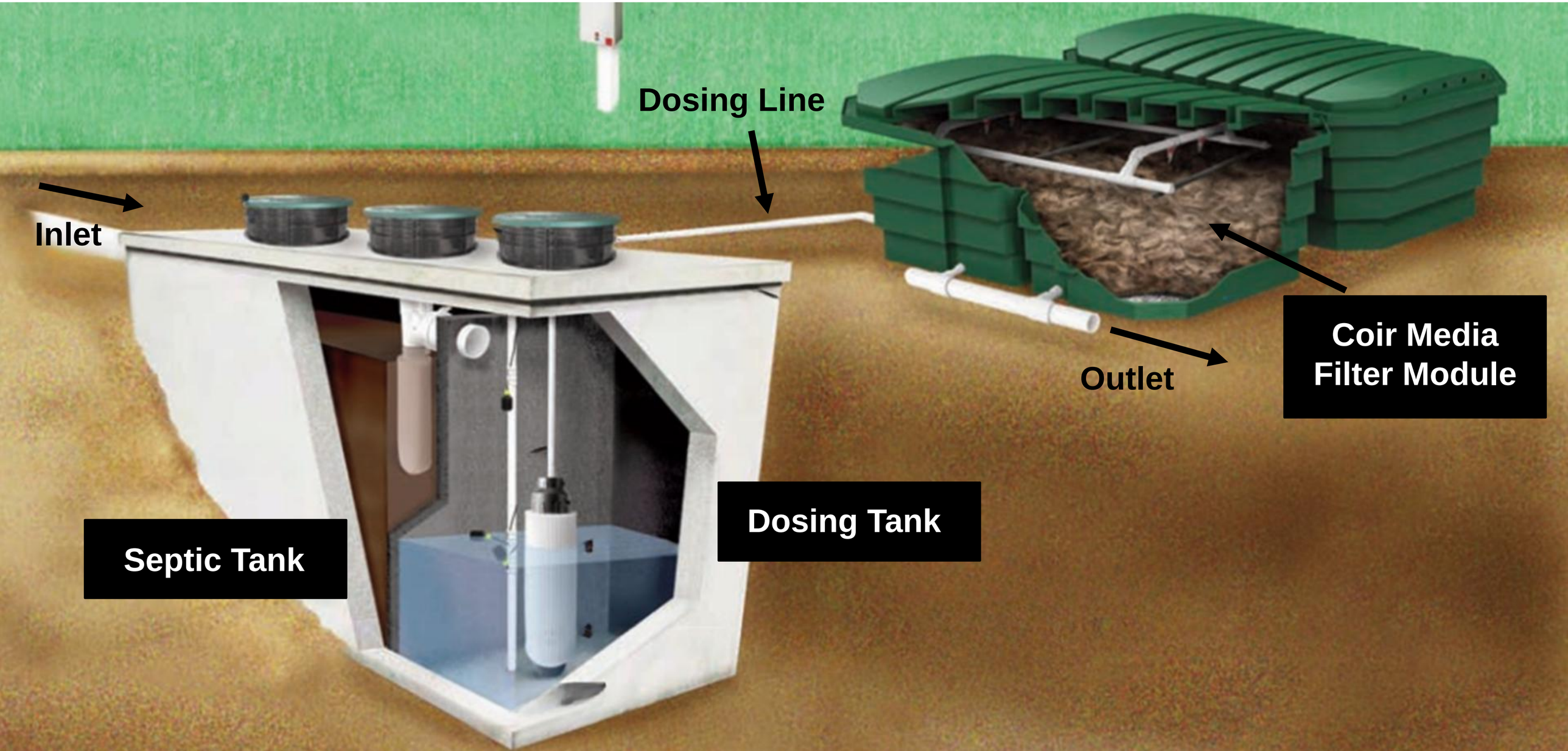
Membrane Bioreactor (MBR)



- Biological Media Filter

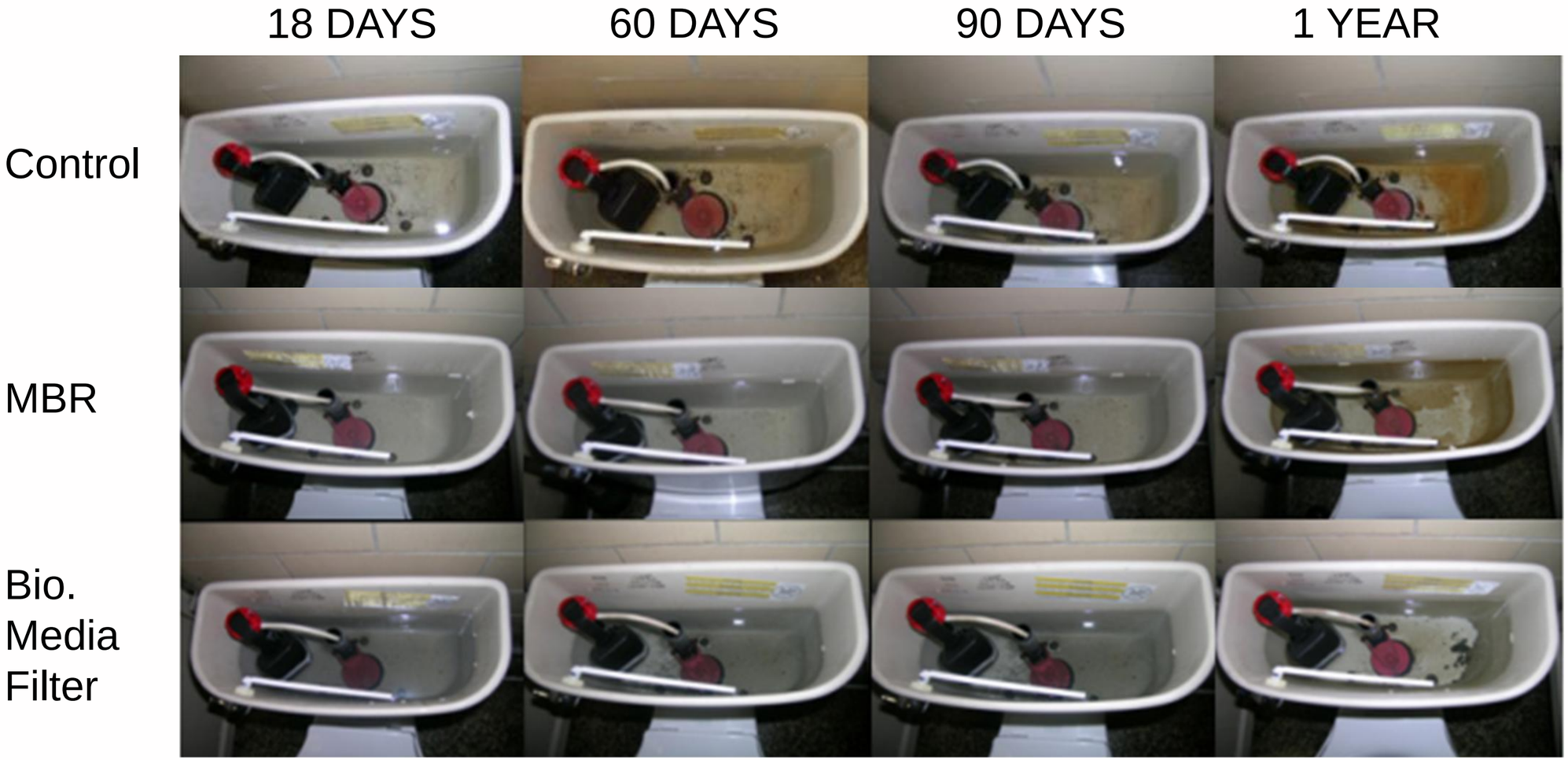
PROS	CONS
Lower cost	Larger footprint due to the additional filter media
Easy to maintain	Final UV disinfection required for reuse application
Excellent effluent quality	

Biological Media Filter




18 DAYS
60 DAYS
90 DAYS
1 YEAR
WATER QUALITY/
USER COMPLAINTS
CONTROL
CITY WATER
Good visual
water quality.
No user complaints.
SYSTEM ONE
FILTRATION & CHLORINATION
Tank walls black when
chlorine level was low.
Complaints about odor.
SYSTEM TWO
ADVANCED OXIDATION (H_2O_2 + UV)
Slimy appearing water
in toilet bowls.
SYSTEM THREE
MEMBRANE BIO-REACTOR (MBR)
Good visual
water quality.
No user complaints.
SYSTEM FOUR
BIOLOGICAL WITH MEDIA FILTER
Good visual
water quality.
No user complaints.

MBR and Bio. Media Filter Results



Good visual water quality and no user complaints.

Biological Media Filter: **Puraflo Coir**

Puraflo Coir

Onsite Non-potable Treatment System

Resilient

Eco Conscious

Low-cost

Low-maintenance

Coconut Coir Filter Media

Coconut Fiber Media

- Proven technology for **> 25 years**

Ideal Media Properties

Virgin Coir

2.5 years used

- Rot-resistant
- Longevity: high lignin content

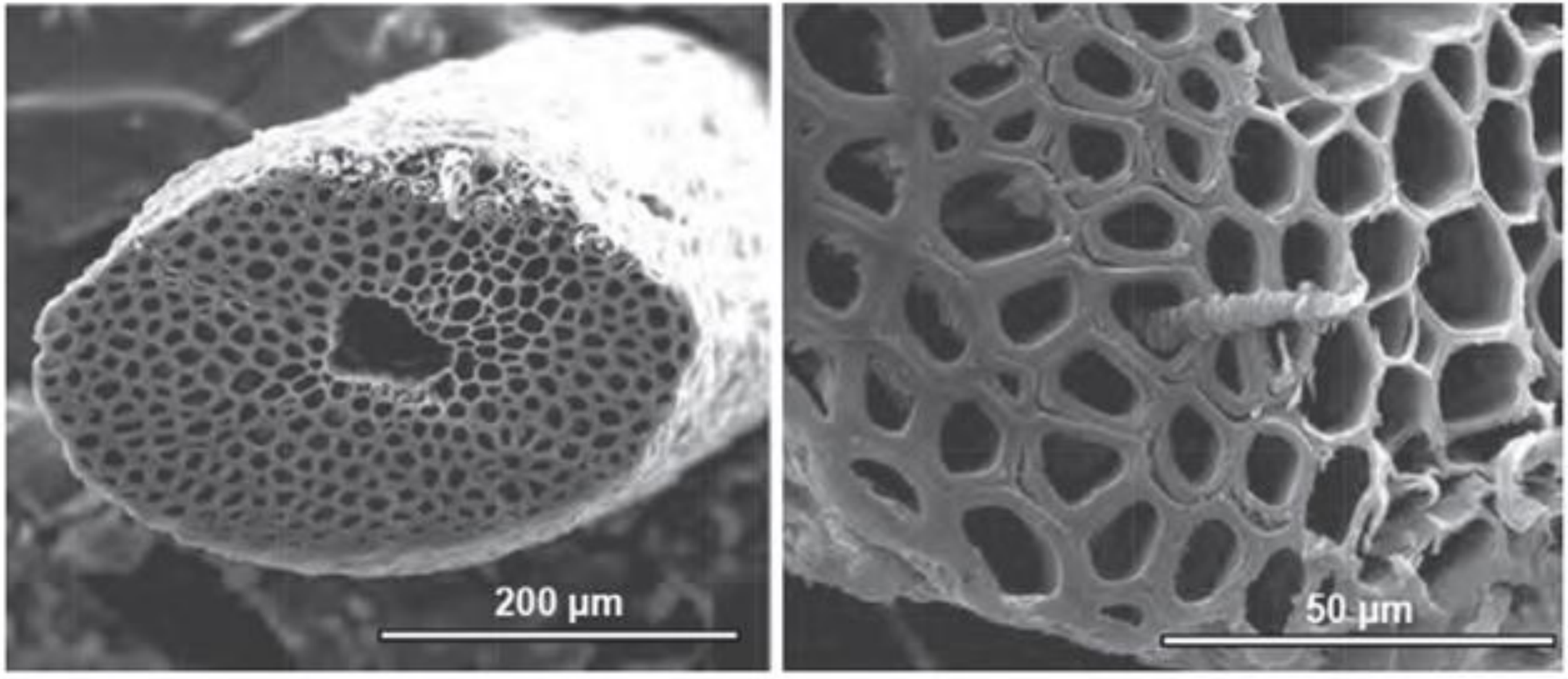


FIGURE 3.4 Cross-section of raw coir fibers shows the cavities and smooth surfaces. Sources from Ferreira et al. (2019) [29].

Puraflo Coir

NSF/ANSI 350 Testing

- Installed July, 2021
- Certification testing: February – July, 2023

Puraflo Coir

NSF/ANSI 350 Testing

Additional Samples

- MS2 Coliphage
- Fecal Coliforms
- Total Coliforms
- Ammonia
- Total Kjeldahl Nitrogen (TKN) - Effluent
- Nitrate/Nitrite - Effluent

Figure 1: Biochemical Oxygen Demand

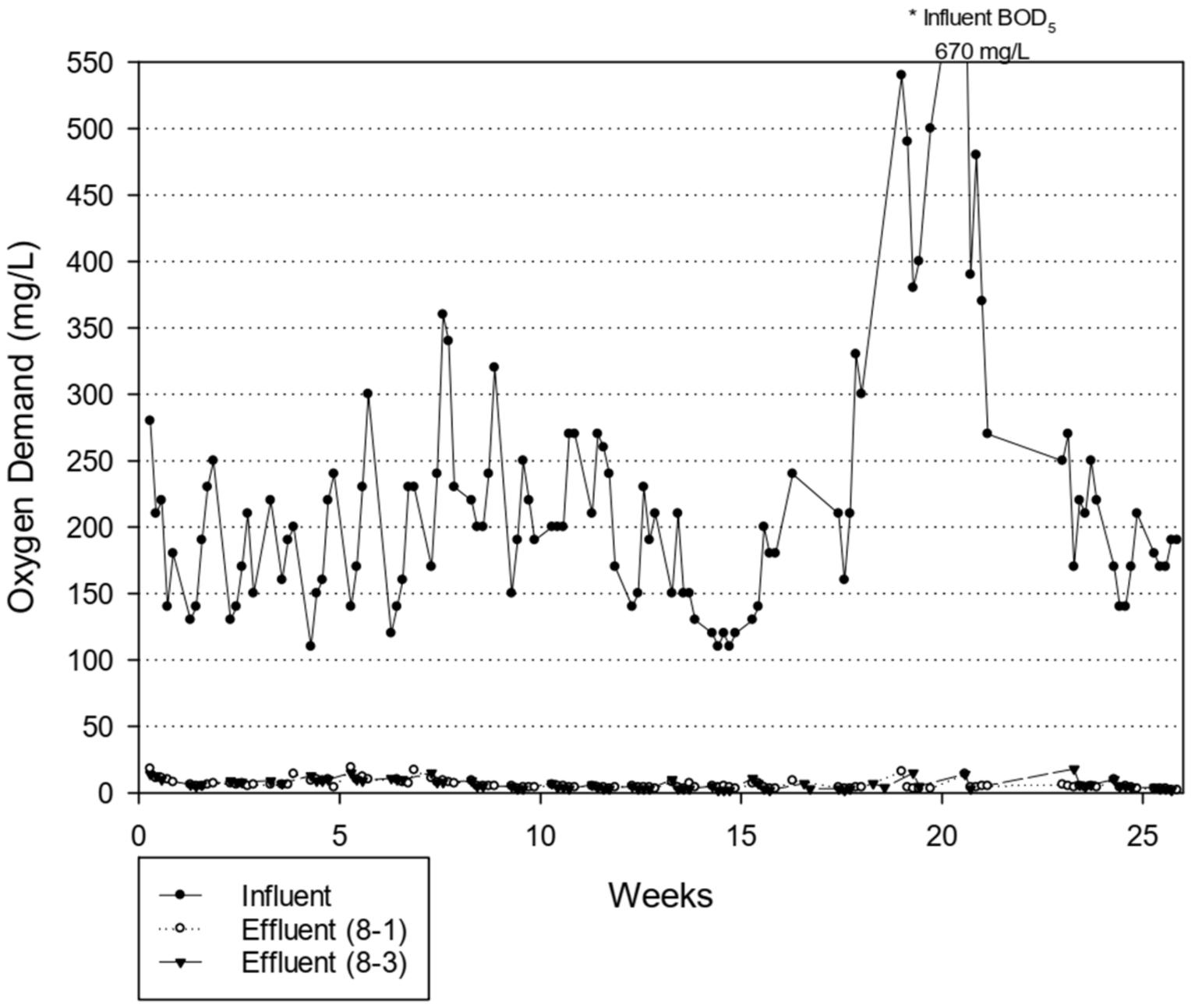
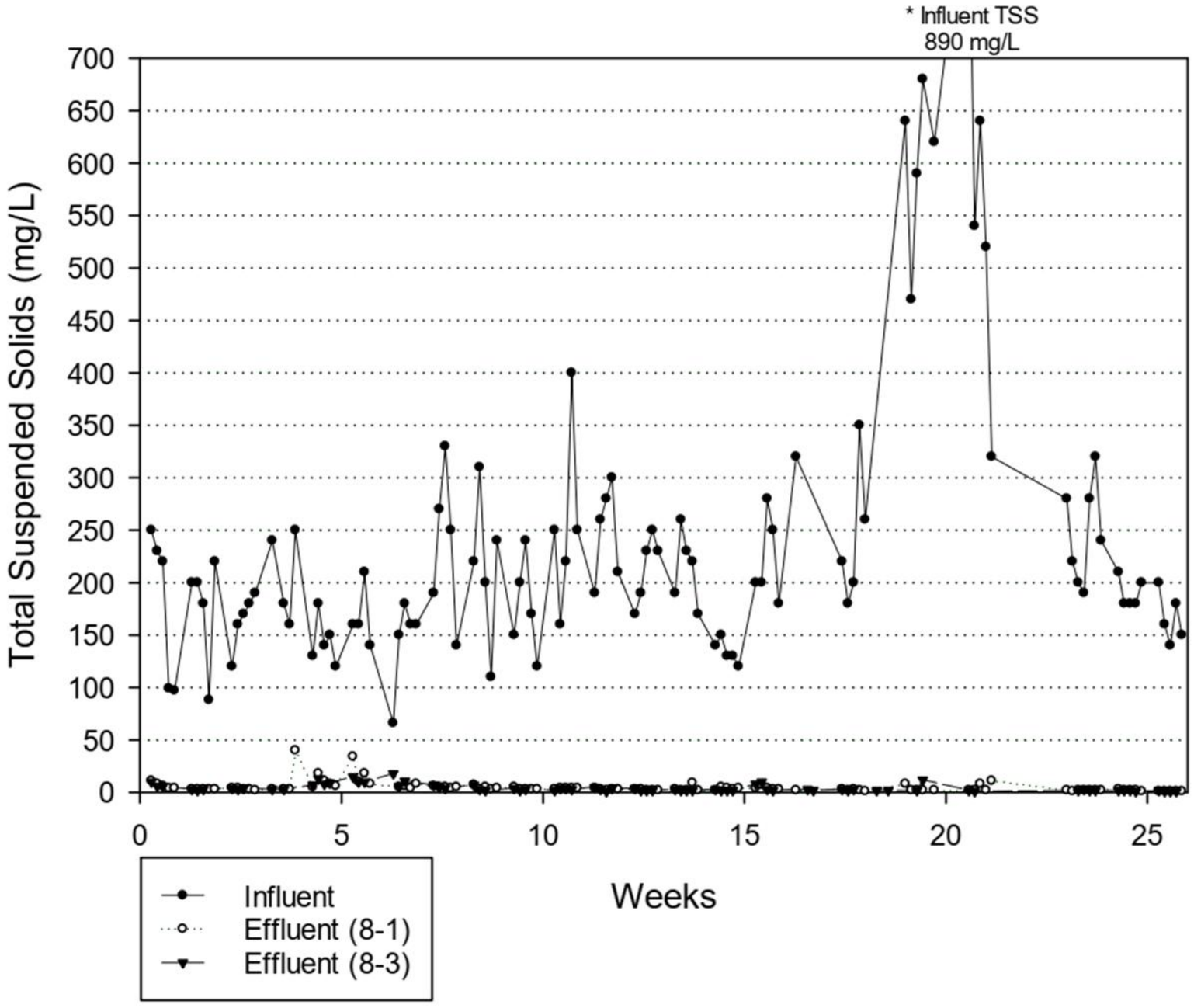


Figure 2: Total Suspended Solids



Influent Testing Results

Parameter	BOD_5	TSS
30-day avg. influent during high strength event	380 mg/L	475 mg/L
Single highest influent samples	670 mg/L	890 mg/L

No drop off in effluent quality during, or after, high strength event.

Certification Test Results

Parameter	Test Average	Single Sample Maximum
$CBOD_5$	6	18
TSS	4	18
Turbidity	4.0	9.8
*E. coli	2.5	1.0E+02

*Average calculated as Geometric Mean

Passed NSF/ANSI 350 certification testing.

Parameters Tested Post UV

Total Coliform

Fecal Coliform

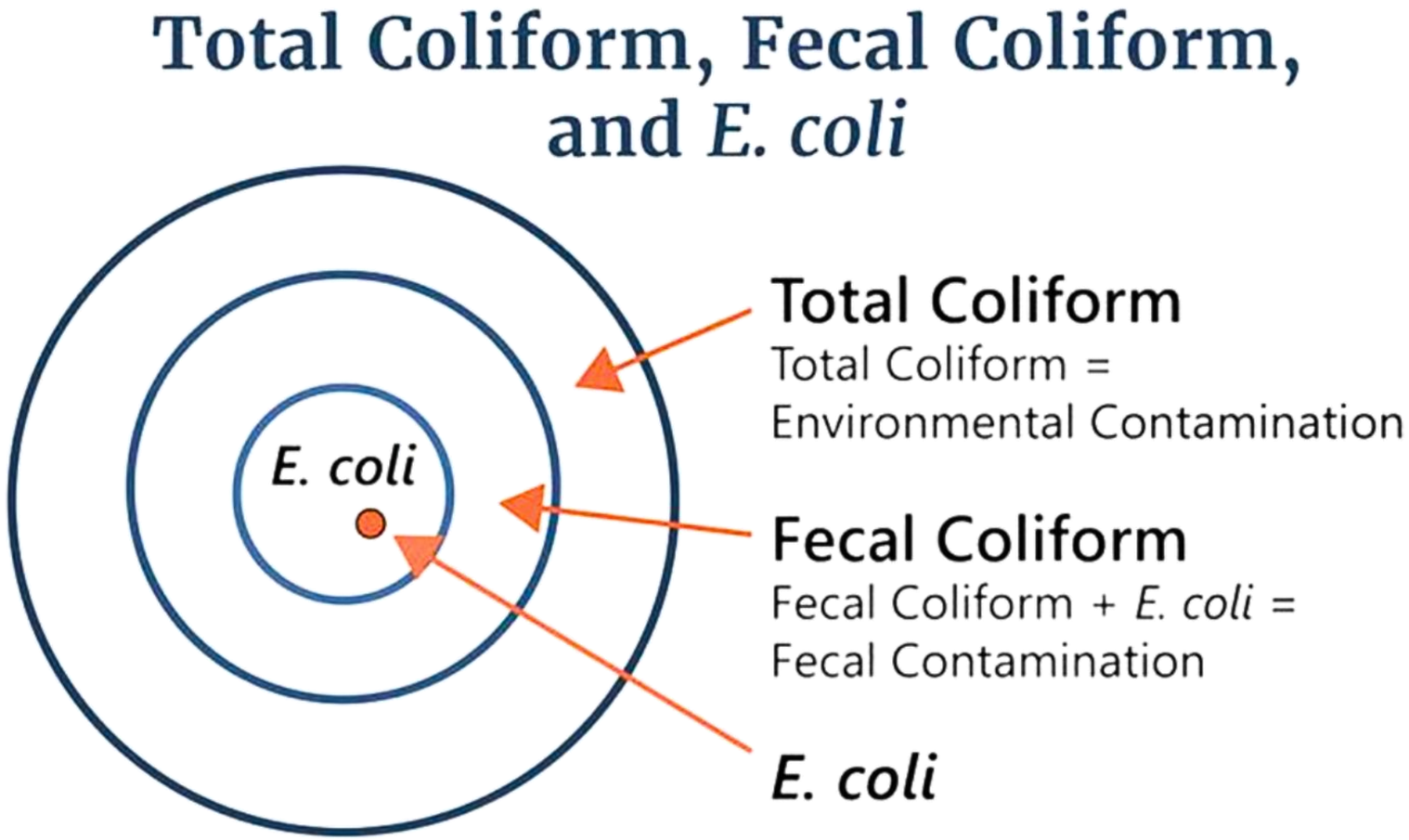
E. coli

MS2 Coliphage

Microbiological Table

Parameter	Test Average	Minimum	Maximum
Total Coliform (Inf.)	4.5E+07	7.4E+02	3.3E+08
Total Coliform (Eff.)	6.0E+02	1.3	2.2E+-04
Fecal Coliform (Inf.)	3.5E+06	4.3E+03	1.7E+07
Fecal Coliform (Eff.)	2.4	1.0	3.3E+04
E. coli (Inf.)	4.5E+06	3.1E+02	2.4E+07
E. coli (Eff.)	2.4	1.0	1.0E+02
Coliphage (Inf.)	7.0E+03	1.4E+03	5.7E+05
Coliphage (Eff.)	1.0	<1.0	1.0

Fecal Contamination Indicator (FIB)



Coliphage Results

Parameter	Test Average	Minimum	Maximum
Coliphage (Inf.)	7.0E+03	1.4E+03	5.7E+05
Coliphage (Eff.)	1.0	< 1.0	1.0

First residential onsite treatment system to incorporate MS2 Coliphage during certification.

Puraflo Coir is ideal as a global ***wastewater reuse solution***.

Water scarcity is a global crisis, and ***it is impacting us***.


One Place Solution
ANUA


Thank You
Questions?
Contact: bradley.hennig@anua-us.com