Future of Designing with Water: The Water Reuse Practice Guide

CA Green Summit
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Clark Brockman, SERA Design
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Steve Castellanos, Derivi Castellano Architects
William Cesanek, CDM Smith
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Linda Derivi, AIACC, DCA
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Susan Freed, County of San Diego
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Katy Lackey, Water Environment & Reuse Foundation
Alexandra Lichtenberg, Same Drop
Eric Lohan, Critical Flow
Scott Schomaker, SERA Design

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Project Manager:
Brett Rosenberg, Treeline Strategy/Urban Fabrick Collaborative

*Bill Worthen, The Urban Fabrick Collaborative*
Earlier this year, we lost a great sustainability champion in the green building world. With the untimely passing of our Collaborative’s amazing leader, we dedicate these presentations and the future launch of The Water Reuse Practice Guide to our dear friend, Bill Worthen.

https://www.collaborativedesign.org/water-reuse-practice-guide
What do you know about water reuse? For most architects and engineers, the typical response to date is ‘not much’. And it’s generally avoided by local regulators, water utilities, and public health agencies.

Participants will learn what you need to know about incorporating onsite or district scale water reuse systems how to determine what types of system will work, permitting in various jurisdictions; what are pros and cons of different technologies; and how to start a policy shift, and address the ‘yuck factor’.
Learning Objectives

- Gain an introduction to Water Reuse and the Water Reuse Practice Guide
- Communicate why all types of water should be considered as a valuable resource, and the benefits of water reuse.
- Learn strategies to integrate water reuse into policy and the building design process.
- Understand how to communicate with stakeholders, collaborate with public agencies to turn policy into practice, and overcome the “yuck” factor.
Why are we here? Why non-potable water reuse?

**Figure 1-5: Non-Potable Demands**

- **Multifamily Residential Water Use**
  - Up to 50% Demands are Non-potable in Multifamily Residential Buildings
  - Source: adapted from Alliance for Water Efficiency

- **Office Water Use**
  - Up to 95% of Demands are Non-potable in Commercial Buildings
  - Source: adapted from USEPA

Source: Urban Fabrick
WAIT…

• Didn’t the Governor just declare the emergency drought is over?
"WHY We Should Care about Water Reuse"

Top 10 Reasons for Onsite Water Reuse

1. Greatly reduces a building’s need for potable water.
2. It extends our limited, valuable, water supply.
3. Increases the resiliency of our cities & urban neighborhoods.
4. It can reduce the cost of water, energy, and money needed for water infrastructure improvements.
6. Eventually, non-potable water reuse will be allowed & may be required in your jurisdiction – Are you ready?
7. It is safe, feasible, and does not smell.
8. Understanding how to address the water-energy nexus in practice is a way to differentiate your firm & project.
9. Can allow projects to better achieve green building certifications without altering the architectural design.
10. It can be a cost-effective option that can get your project closer to zero net energy & water operations, sometimes expediting planning and entitlement reviews where these goals are incentivized.
1. What *is* Non-potable Water Reuse?

Water is a valuable resource!

All water is recycled water!
1. Water As a Valuable Resource

FACTORS THAT CONTRIBUTE TO OUR AGING & STRESSED CENTRALIZED WATER SYSTEMS:

- Aging Infrastructure
- Prolonged Drought
- Extreme Weather Events
- Lack of Knowledge

Our Water Infrastructure is a Linear Single-use System

Potable water is brought into building and waste water is discarded requiring energy pumping, storage and treatment.

We Simply Don’t Understand that ALL Water is a Resource

- Infiltration & Inflow
- Shower/Bath
- Dishwater
- Clothes Washer
- Sinks
- Feces
- Urine

Source: J.S. Guest
1. Water As a Valuable Resource

Source: Howe and Mukhieber, 2015.
2. Fit for Purpose: The Right Water for the Right Job

**FIGURE 2-2: ALTERNATIVE WATER SOURCES**

This diagram shows the main alternate water sources available in the urban environment, and the basic treatment each one needs to undergo to reach non-potable water quality for each non-potable reuse.

- **Blackwater**
  - Wastewater from toilets, dishwashers, kitchen sinks and utility sinks

- **Graywater**
  - Wastewater from clothes washers, bathtubs, showers and bathroom sinks

- **Foundation Drainage**
  - Nuisance groundwater from dewatering operations

- **Rainwater**
  - Precipitation collected from roofs and above-grade surfaces

- **Condensate**

- **Evaporative cooling**

- **Stormwater**
  - Nuisance groundwater from dewatering operations
2. Understand the Water-Energy Nexus

Source: Water Environment & Reuse Foundation
2. Fit for Purpose: The Water-Energy Nexus
Is Non-Potable Reuse Right For Your Project?

Learning Objectives:
- Assess the requirements
- Ask the right questions
- Determine when non-potable reuse makes sense

Non-potable water reuse may not be appropriate for every type or scale of project. Make a checklist to assist in thinking through the important points below.
3. How Do We Handle Our Water Supply?

**HOW DO WE HANDLE OUR WATER SUPPLY?**

1. **WATER USE**
   - Does the proposed development exceed the city's potable allocation?
     - Yes: Reconsider development
     - No:
       - Yes: Are all non-potable uses being supplied by non-potable water in the proposed development scenario?
         - Yes:
           - Yes: Consider producing muni recycled water to cover non-potable uses and leave enough for others.
           - No: Consider producing recycled water on-site.
         - No: Recalculate.
       - No: Consider producing recycled water on-site.

2. **CAPACITY**
   - Is there enough capacity to produce muni recycled water to cover non-potable uses and leave enough for others?
     - Yes:
       - Yes: Consider a partnership to expand the plant's operation.
       - No: Use muni recycled water.
     - No: Consider producing recycled water on-site.

3. **TIMELINE**
   - Is the timeline for providing those quantities in line with the proposed development?
     - Yes:
       - Yes: Consider a partnership to expand the plant's operation.
       - No: Use muni recycled water.
     - No:
       - Yes: Consider producing recycled water on-site.
       - No: Recalculate.

4. **FINANCE**
   - Does the plant have financial resources to produce this amount?
     - Yes: Consider a partnership to expand the plant's operation.
     - No: Use muni recycled water.
3. How Do We Handle Our Wastewater?

HOW DO WE HANDLE OUR WASTEWATER?

Does code require us to treat on-site?
- YES: Treat On-site
- NO: Capacity

Is there enough capacity at the WWTP for future growth, while allowing space for others?
- YES: Treat On-site
- NO: Timeline

Is the timeline for providing expanded capacity in line with the timeline of the proposed development?
- YES: Finance
- NO: UNCERTAIN

Does the plant have financial resources to expand its treatment capacity?
- NO: Consider a partnership to expand the plant’s operation to benefit the city + treat off-site
- YES: Treat On-site
  - Consider Resource Recovery options

Is there a WWTP within x # of miles? Or uses less than x kWh to convey wastewater to the plant?
- NO: Treat On-site
- YES: Energy + Emissions

Does the WWTP recover resources?
- NO: Consider partnering with 3rd party to provide resource recovery
- YES: RESOURCE RECOVERY

Consider partnering with 3rd party to improve resource recovery
3. Decision Tools

3. Drivers: Water Pricing

Seattle and Atlanta have the highest total monthly bills. Each is building costly underground storage facilities and treatment plants to comply with federal requirements to reduce raw sewage that is dumped into lakes and rivers.

Santa Fe has the highest water prices in the survey. The small city of 75,000 recently completed a $67 million pipeline from the Rio Grande.

San Francisco and Los Angeles are also cost leaders. San Jose is another.

Baltimore has stormwater fees that are mandated by state law as part of a program to keep polluted runoff from entering the Chesapeake Bay.

Source: Circle of Blue –
3. Drivers: Risk

Source: CEO Water Mandate -
3. Drivers: Risk

Source: CEO Water Mandate -
4. Communication & the “Yuck” Factor

Source: SFPUC and WE&RF
4. Communication & the “Yuck” Factor

![IMAGE: INTERNAL VS. EXTERNAL STAKEHOLDERS]

**Table: Internal Stakeholders**

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developer/Owner</td>
<td>Cost efficiency, Regulatory compliance, Brand enhancement</td>
</tr>
<tr>
<td>Design Team/Builder</td>
<td>Positive industry reputation, New expertise</td>
</tr>
<tr>
<td>Occupants</td>
<td>Ease of use, Control over rate increases</td>
</tr>
<tr>
<td>Facility Manager</td>
<td>Seamless, cost effective, reliable operations</td>
</tr>
</tbody>
</table>

**Table: External Stakeholders**

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulators</td>
<td>Protect public health and water quality, Conserve scarce resource, Enforce code compliance</td>
</tr>
<tr>
<td>Utilities</td>
<td>Guarantee water supply, Maintain revenue</td>
</tr>
<tr>
<td>Financial institutions</td>
<td>Avoid risk, Maintain long term value of investment</td>
</tr>
</tbody>
</table>

*Source: Urban Fabrick*
4. Communication & the “Yuck” Factor

- **89%** of California residents are more willing to use recycled water after learning about the treatment process.
- **90%** referring to reused water as “purified water” gamers stronger support for its use as an additional local water supply than “recycled water” or “reclaimed water.”
- **87%** of Californians agree that the drought has made them more supportive of **RECYCLED WATER.**

Source: Xylem Water Reuse Survey
5. Integrate Water Reuse into Design

Image: 101 Fremont, San Francisco
5. Projects: SFPUC Headquarters – San Francisco, CA

TFW - Tidal Flow Wetland

SFPUC Headquarters – Living Machine
5. Projects: Hassalo on 8th – Portland, OR
5. Projects: Hassalo on 8th – Portland, OR

NORM: “Natural Organic Recycling Machine”
@PortlandNORM
5. Projects: TransBay Terminal – San Francisco, CA
6. Permitting

Final Report

Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-Potable Water Systems

Source: Sharvelle et al., 2017
(WE&RF Project No. SIWM10C15)
7. Onsite Reuse Technologies

- Membrane Bioreactor
- Rotating Biological Contactor
- Intensive ‘Natural’ Filtration
- Constructed Wetland

Energy Use vs. Space Requirements:
- Energy Use: LOW to HIGH
- Space Requirements: LOW to HIGH
7. Onsite Reuse Technologies

Looking forward…
from on-site treatment to resource recovery:

Bio-gas
Biosolids
NPK Recovery
Transforming Jurisdictions

BLUEPRINT for Onsite Water Systems
A Step-by-Step Guide for Developing a Local Program to Manage Onsite Water Systems

Source: SFPUC and WE&RF
• Sustainable City Plan - 1994
• 15 x 15 Climate Action Plan
• Water Self-Sufficiency by 2020
• 100% Green Power
• 100% Renewable Energy Goal for Big Blue Bus Fleet
• 7.5 MW Solar Capacity Installed by 2020
• Carbon Neutrality by 2050
• First Municipality to Construct a Living Building
• Mandatory Solar on All New Construction
• First City to Require ZNE for all New Homes
But the Drought is Over, Right?

- Energy Independence
- Preserve Rainforests
- Sustainability
- Green Jobs
- Livable Cities
- Renewables
- Clean Water, Air
- Healthy Children
- Etc. Etc.
Water Self-Sufficiency – City Scale

It’s up to us Santa Monica

WATER SELF-SUFFICIENCY BY 2020

sustainablesm.org
Water Self-Sufficiency – City Scale
City Services Building – Living Building Challenge
A CALL TO ACTION:

living. building. challenge.

www.livingbuildingchallenge.org
The Paradigm Shift

- Code
- Green
- High Performance
- Living Building Challenge
- Positive Regenerative Impacts
- Negative Environmental Impact
- Sustainable
A Global Movement
Net-Zero Water

100% of project water needs must come from captured precipitation or reused water purified without chemicals
NET ZERO WATER: Strategies for Achievement

This Imperative may be attempted using the Scale Jumping design overlay, which endorses the implementation of solutions beyond the individual project scale that maximize ecological benefit while maintaining self-sufficiency at the city block.
City Services Building – Water Budget

SUPPLY
- Rain water (no drought)
- Grey water
- Municipal Water

DEMAND
- Irrigation water
- Toilet water
- Shower water
- Kitchen water
Seattle – Santa Monica Water Forum

Agencies coming together to design the environmentally restorative buildings of the future.

January 15th, 2015
10am – 5pm
Bullitt Center, Seattle
Guidelines for Alternate Water Sources:
Indoor and Outdoor
Non-Potable Uses

Los Angeles County Department of Public Health
February 2016

Source: Los Angeles County Public Health
http://publichealth.lacounty.gov/eh/docs/ep_cross_con_AltWaterSourcesGuideline.pdf
**Changing the Codes**

### INDOOR USES

Graywater systems may be used at single family dwellings, apartments (R1), hotels (R2), commercial, institutional, and municipal facilities.

**Includes:** "Graywater" that is collected and used onsite. Graywater systems may also use water from swimming pool backwash operations, air conditioner condensate, cooling tower blow-down, steam system condensate, fluid cooler discharge water, food steamer discharge water, combination oven discharge water, industrial process water, fire pump test water, theme park recreation water operations, and foundation drainage. Systems that combine rainwater and graywater are classified as graywater systems.

**Excludes:** Stormwater, dry weather runoff (see instead Tier 3: Stormwater), and wastewater from kitchen sinks or toilets (see instead Tier 4: Recycled Water).

<table>
<thead>
<tr>
<th>Allowed Uses</th>
<th>Min. Water Quality Standard</th>
<th>Treatment Process</th>
<th>Monitoring &amp; Reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toilet and urinal flushing</td>
<td>NSF 350 with disinfection or CCR Title 22</td>
<td>Packaged Units and/or Design Build Units – evaluated and complying with NSF 350 certification standard as a complete system</td>
<td>Owner-Occupied, Single Family Dwelling: Upon installation and change of ownership</td>
</tr>
<tr>
<td>Laundry washing</td>
<td>Recycled Water Quality Equivalence at the point of use or Other standard matching or exceeding presently accepted standards</td>
<td>Evaluated on a case-by-case basis per project</td>
<td>• R1 &amp; R2: Annually (Quarterly if used for laundry washing)</td>
</tr>
<tr>
<td>Trap primers and cooling tower make-up</td>
<td></td>
<td></td>
<td>Commercial/institutional/industrial: Annually (Quarterly if used for laundry washing)</td>
</tr>
</tbody>
</table>

**Requirements**

- Permits/approvals:
  - Shall obtain Building & Safety Building Permit from the local building authority
  - Shall undergo Public Health Plan Review and Approval of the piping system, tanks, and pump, in order to reduce risk of cross connection with potable water supplies
  - Non-NSF certified systems shall complete a 6 month demonstration phase showing water continually meets standard prior to treated graywater being used for any purpose other than subsurface irrigation

- Non-NSF certified systems shall be certified to meet NSF 350 or other applicable water quality standard by a 3rd party tester approved by DPH EII

- R1, R2, Commercial, Institutional, and industrial systems including spray irrigation, outdoor water features, and vehicle washing must have manual developed by the engineer who designed the system identifying operation and maintenance of the system, online water quality

- Shall be screened or be otherwise equipped to prevent vector intrusion

- Shall incorporate failsafe designs to comply with failure sensing and signaling equipment standards in NSF 350

**February 2018 | 6**
At this time, it remains unclear if the LA County Department of Public Health will consider sources other than rainwater collected from a roof as eligible for potable water treatment.
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Questions ?