Onsite Water Reuse Lessons Learned

Tips and Recommendations from the Field for Successful Design, Operations, Maintenance, & Implementation

San Francisco
Water Power Sewer
Services of the San Francisco Public Utilities Commission

CONTENTS

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SAN FRANCISCO'S ONSITE WATER REUSE PROGRAM

In 2012, San Francisco established the Onsite Water Reuse for Commercial, Multi-Family and Mixed-Use Development Ordinance. Commonly known as the Non-potable Water Ordinance, it added Article 12C to the San Francisco Health Code, allowing for the collection, treatment, and use of alternate water sources for non-potable uses in buildings. In 2013, the Non-potable Water Ordinance was amended to allow for district-scale projects, where two or more parcels can share alternate water sources. In 2015, Article 12C became mandatory and required new development projects of 250,000 square feet or more of gross floor area to install and operate an onsite non-potable water system. In October 2021, Article 12C was amended to further increase potable water savings from new developments and increase opportunities for cost-effective systems. Article 12C now applies to new development projects of 100,000 gross square feet and contains new requirements for different project types. For commercial buildings, the project must meet its toilet and urinal flushing and drain trap priming demands through the collection, treatment, and use of available blackwater and condensate. For residential and mixed-use buildings, the project must meet its toilet and urinal flushing, irrigation, clothes washing, and drain trap priming demands through the collection, treatment, and use of available graywater and condensate. For more information, visit **www.sfpuc.gov/npo**.

This guidebook provides lessons learned in the form of tips and recommendations to assist Design Engineers, Treatment System Managers, Operators, and other stakeholders involved in designing, operating, and implementing an onsite water treatment system. Several practitioners contributed their insights based on real-world experience with onsite water systems. This guidebook focuses on key components for successful implementation that may be forgotten or overlooked to date. By sharing these lessons learned, SFPUC hopes to inspire thoughtful choices and process change improvements that can be implemented over the life of the onsite water system.

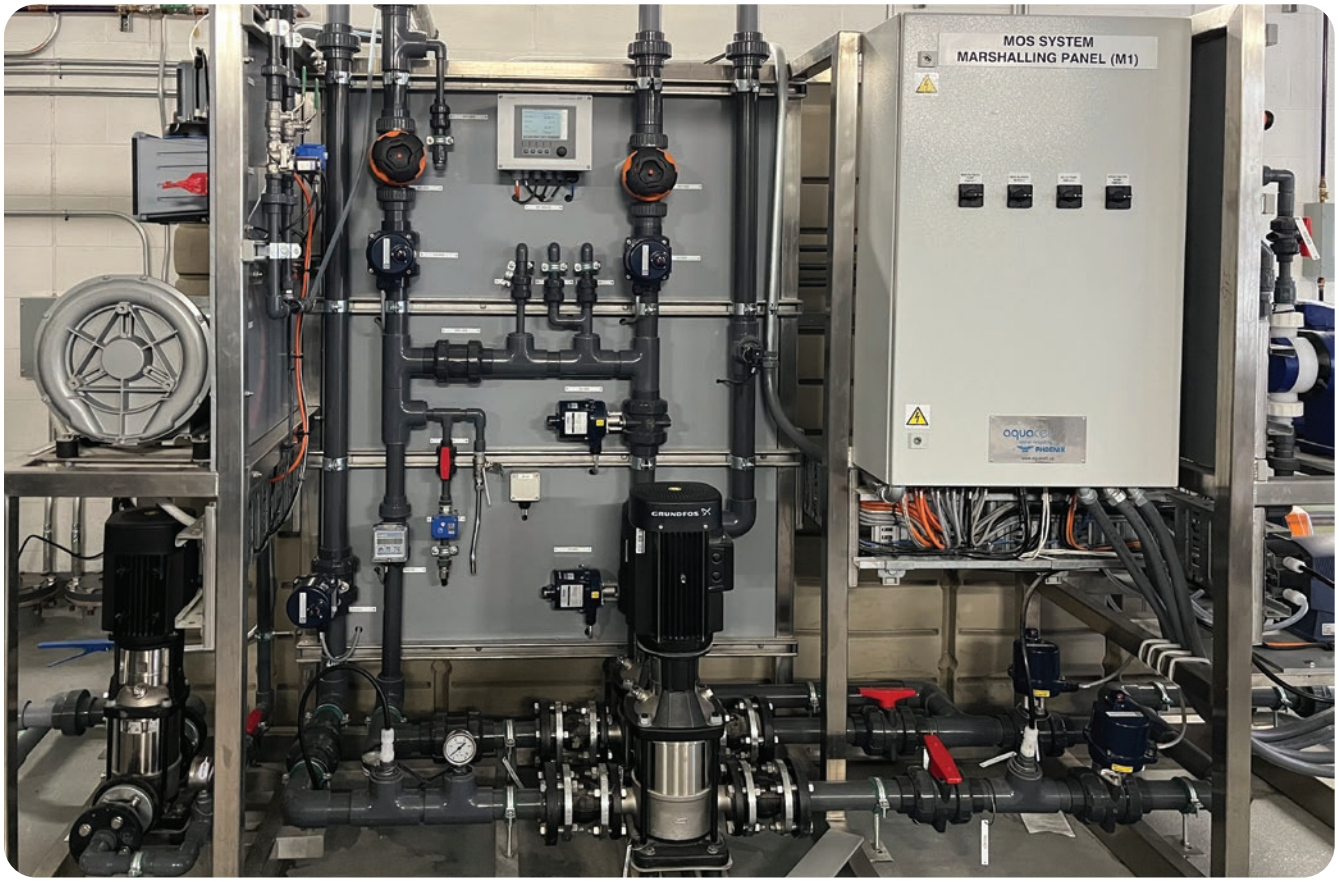
TIPS FOR DESIGNING ONSITE WATER TREATMENT SYSTEMS

Design onsite water treatment systems to minimize odor

- Design rooms that contain the water treatment system with adequate ventilation that moves air to the outside of the building
- Use of activated charcoal (carbon) filters can be effective at removing odors
- Ensure P-traps are not dried out, especially in unoccupied or low occupancy units

Design onsite water treatment systems to control for color in treated water

- Include microfiltration to filter for color
- Consider adding colored dye to the treated water for a more pleasant color



Mission Rock's district-scale blackwater treatment system is the first of its kind in San Francisco. The system will meet all of the demands for toilet and urinal flushing and irrigation and is estimated to offset about 55% of the development's total water demand.

TIPS FOR DESIGNING ONSITE WATER TREATMENT SYSTEMS

Design onsite water treatment systems to accommodate planned and unplanned shutdowns

- Ensure the system's programming logic allows booster pumps to operate when the treatment system is down for maintenance and/or include a bypass to the potable water supply with proper backflow protection for end uses such as toilet flushing
- Incorporate backup power to minimize disruptions to the treatment system, monitoring equipment, and flow meters
- Check that electronic flow totalizers or data storage in a programmable logic controller (PLC) do not reset to zero or lose memory in the event of a power outage
- Consider how and where to monitor chlorine residual during commissioning and routine maintenance when treated water is diverted to sewer and potable makeup water is going to the end use

Properties that have onsite water reuse systems must include a containment reduced pressure principle backflow prevention assembly located as close as practical to, but in any case within 25 feet downstream of the point of connection to the public water system or water meter, and an air gap at the point of potable make-up to the non-potable system.

Performance data of the stormwater treatment system at Francisco Park is viewable on a simple and accessible screen by the Treatment System Manager and park maintenance staff.

TIPS FOR DESIGNING ONSITE WATER TREATMENT SYSTEMS

Design onsite water treatment systems to ensure access to the internet at the start of construction

- Relay the internet access requirement to the installation crew during the building phase
- Run a dedicated hardline during construction
- Plan ahead with building owners who may have cybersecurity concerns

Design onsite water treatment system areas to minimize water from accumulating on the floor

- Funnel drains and pipe reducing fittings can be effective at reducing water spilling from air gaps
- Well-placed floor drains and floor pitching are important to optimize drainage
- Design the size of drainage and overflows to be at least as big as the inflow

Treatment System Managers can monitor system performance from their computers and receive notifications of alarms when the system isn't performing properly.

Potable make-up water is supplied to the treated water storage tank via an air gap.

TIPS FOR DESIGNING ONSITE WATER TREATMENT SYSTEMS

Design considerations for onsite water tanks and cisterns

- Clean out the debris that can collect inside tanks during construction as debris will result in clogging of filters and treatment failure during commissioning
- Installation of large polyethylene tanks can be challenging due to the need to open walls, which may extend crane usage onsite
- Consider installation of smaller, modular tanks as they can be easier to install in different configurations by smaller teams without relying on the building-wide construction schedule
- Include mosquito abatement techniques, such as mosquito exclusion screens, monitoring tanks for mosquito larvae, and applying potable makeup water to agitate the surface during dry periods when water at the bottom of the tank remains stagnant

The EcoCenter at Heron's Head Park is showcasing sustainability with its own solar energy system, living roof, and onsite rainwater harvesting.

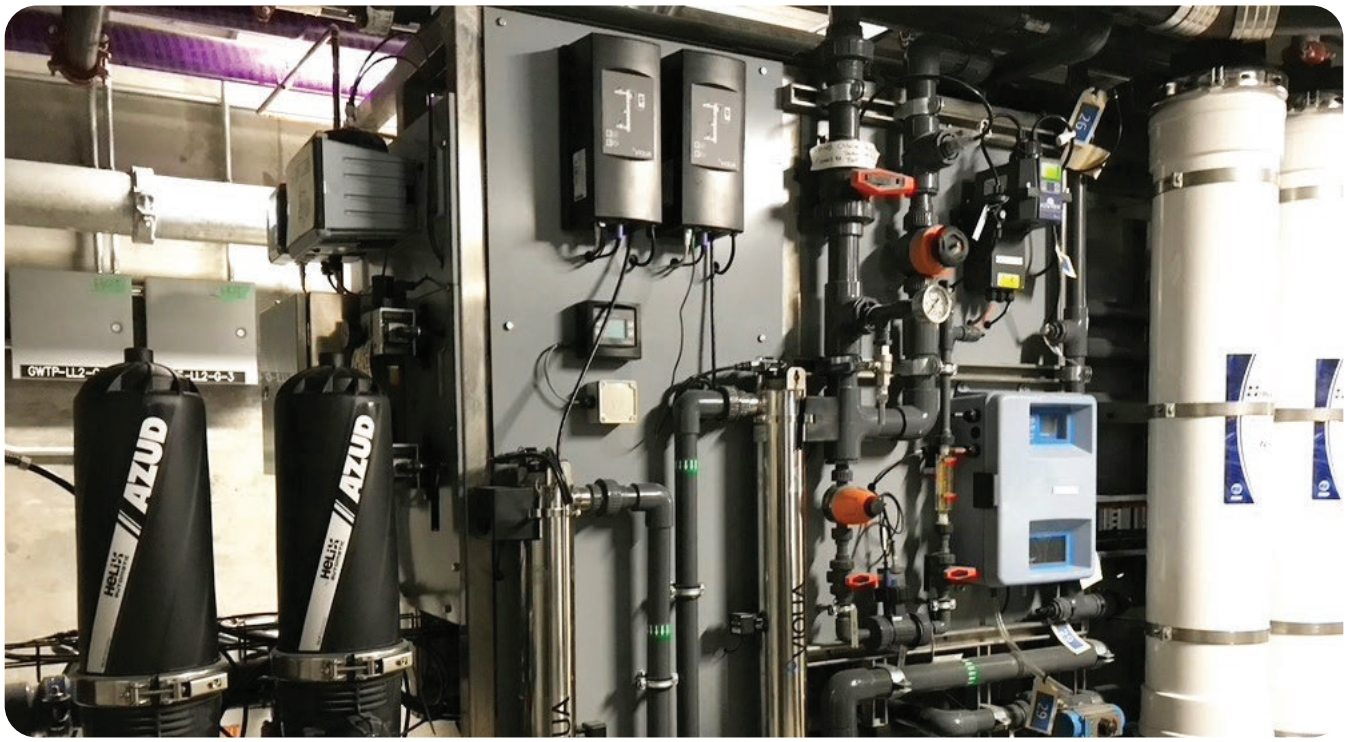
Design considerations for onsite rainwater treatment systems

- Prevent treatment system failures during dry months by adding potable water for periodic filling of the rainwater collection tank
- Use first flush diverters for the first rainfall of the season
- Attach mesh or other filters to roof drains to exclude debris from rooftop landscaping, iron, and oils from entering the treatment system

TIPS FOR DESIGNING ONSITE WATER TREATMENT SYSTEMS

Design considerations for onsite graywater treatment systems

- Incorporate design features to account for hair and debris to minimize operational challenges



Chase Center, the sports and entertainment complex in San Francisco's Mission Bay neighborhood, is designed to collect and treat rainwater, stormwater, graywater, and condensate to supply toilet flushing demands in the arena and two accompanying office buildings.

Design considerations for operation and maintenance

- Consider future retrofits and ease of maintenance for both people and equipment, especially for components requiring regular servicing such as UV systems
- Consider overhead restrictions (e.g., fire suppression systems and other piping) with the design for tank access and for lifting devices (e.g., pulleys) when lifting heavy components such as pumps
- Communications can break down during the transition from construction to operations if the treatment system vendor is not the same entity who will operate the system long term

TIPS FOR DESIGNING ONSITE WATER TREATMENT SYSTEMS

Energy Center San Francisco captures foundation drainage from Powell Street station and redirects it to their District Energy Plant nearby for producing steam. The plant has an eye wash station for the safety of all personnel working on the onsite treatment system.

Other design recommendations

- Design treatment systems to meet maximum flow, not average flow
- Include safety equipment such as chemical showers, eye washes, spill kits, and chemical hazard labeling
- Wait to install media filters until they are ready to be used as media filters can solidify if sitting unused during construction
- To ensure accurate reporting of potable makeup water use to SFPUC and SFDPH, it's critical to (1) design the potable makeup flow meter to measure flows in tandem with the flow control system is used, and (2) ensure the flow meter can accurately record the full range of expected flows including low flows
- Where possible, look for partnership opportunities with nearby developments to explore a district-scale water reuse system as district-scale approaches can reduce operations & maintenance and result in a shorter payback period

TIPS FOR OPERATIONS & MAINTENANCE

Tips for commissioning onsite water treatment systems

- Make sure both the Design Engineer and the Treatment System Manager participate in system commissioning for a successful startup and to ensure the protection of equipment and adherence to manufacturer warranties
- Review SFPUC's **Guidebook for Commissioning an Onsite Water Treatment System in San Francisco** for more info on starting up a system
- Thorough alarm testing is essential; test that each critical alarm correctly triggers automatic diversion

Tips for ongoing operation and maintenance

- Supply chain issues can impact the ability to perform maintenance and increase costs
- Order extra parts that can be stored long term
- Think critically about suppliers and manufacturers for longevity
- Design systems to be retrofitted for new or similar component(s)

In the basement of the Salesforce Tower, the building has an onsite blackwater system that is designed to capture all of the building's wastewater, treat, and reuse it for toilet flushing and drip irrigation.

TIPS FOR OPERATIONS & MAINTENANCE

- Understand the logistics of chemical deliveries, receiving, handling, safety, and training early on to avoid surprises or delays
- Find a cost-effective chemical supplier that can deliver directly to treatment locations to reduce time spent receiving and moving shipments
- Optimize system performance by making incremental adjustments over time that can increase the water savings of the system
- Decisions should be made early in the process if building owners want HOAs to maintain and operate an onsite water treatment system by documenting and engaging in early discussions about HOA responsibilities
- Consider retaining an owner's representative with the right technical expertise to oversee O&M

The Treatment System Manager of the combined graywater and rainwater treatment system at 1550 Mission uses chlorine to maintain a disinfectant residual to provide protection against opportunistic pathogens such as Legionella.

TIPS FOR OPERATIONS & MAINTENANCE

Considerations for membrane bioreactors (MBRs)

- MBRs can take weeks or months to establish a stable population of microorganisms needed to meet treatment standards and complete commissioning
- Build in sufficient time to test the MBR during commissioning
- Reduced influent due to low occupancy impacts the operability of MBRs as they need consistent influent to treat water effectively
- Consider separating graywater or blackwater treatment skids with MBRs from rainwater treatment skids so they can be operated independently

Considerations for wetland treatment systems

- Minimize chemical fertilizers with constructed wetland onsite treatment systems

SFPUC's headquarters was constructed with an engineered wetland treatment system that treated the building's blackwater for reuse for toilet and urinal flushing. The onsite water reuse system is undergoing modifications to upgrade the treatment system and incorporate a permanent purified water demonstration.

TIPS FOR TRAINING & MANAGEMENT OF ONSITE WATER TREATMENT SYSTEMS

Ensure staff have proper training on safe operations, water treatment, and regulatory compliance

- Identify the Treatment System Manager early and plan for multiple trainings
- Train building staff on how to handle routine maintenance (e.g., visual checks for obvious issues such as leaks, olfactory checks, or auditory checks for abnormal equipment sounds) as this can help avoid paying for additional Treatment System Manager visits as well as provide early warning of potential problems
- Document changes to the standard operating procedures on an ongoing basis, including the "why" behind the changes as Treatment System Manager transitions can result in loss of institutional knowledge
- Treatment System Managers should maintain frequent contact with local regulators to track ownership transitions

Develop an O&M staffing plan

- Develop an O&M staffing plan to identify time commitments and type of staff needed
- Identify a backup Treatment System Manager for vacation and other coverage needs as issues cannot be resolved quickly if they're unavailable

The Treatment System Manager can train building staff to perform routine inspections and maintenance.

TIPS FOR OWNERSHIP OF ONSITE WATER TREATMENT SYSTEMS

Considerations for long-term asset management should be understood by property owners

- Educate property owners that ongoing management and maintenance is required and will involve additional expenses
- Ensure Treatment System Managers and building ownership agree to a plan to respond to unforeseen expenses (e.g., maintain a reserve budget or implement a process for approving emergency budget needs)
- Communicate to the property owner that excess use charges from the SFPUC can be applied for not operating a system which can be costly and worth consideration by owners when looking at the entire financial picture
- Ensure that designers and long-term O&M entities have sufficient communication during the critical construction-to-operations handoff

San Francisco's Public Safety Building operates a rainwater system that treats rainwater collected from the roof for sub-surface irrigation and cooling tower makeup

181 Fremont is a mixed-use residential building capturing graywater and rainwater, treating, and reusing it for toilet flushing and irrigation.

TIPS FOR COMMUNICATING WITH USERS

Considerations for building signage

- Signage in bathrooms and common areas is required and presents an opportunity to engage occupants and visitors about conserving water with onsite water treatment systems

Develop educational materials for building occupants

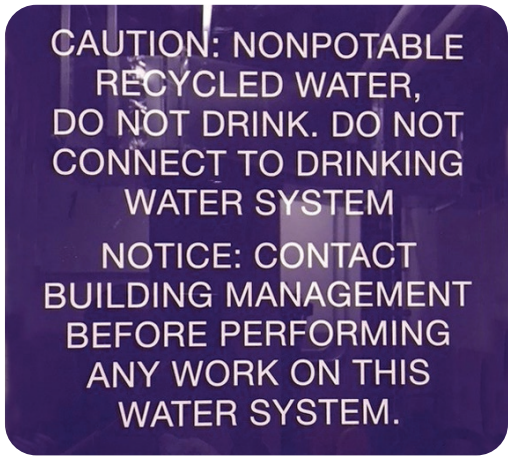
- Develop educational information identifying what specifically can't go down the drain; communicate this to building occupants on an ongoing basis
- Where possible, remove products from the building that could damage treatment processes (e.g., disinfecting wipes)

Prioritize outreach to janitorial and/or kitchen dining services

- Ensure ongoing outreach to educate kitchen/dining services and/or janitorial staff about appropriate cleaning products (disinfecting products such as quaternary ammonia compounds can impact the treatment process)

Other communications considerations

- Personification of an onsite water treatment system can be a fun and engaging way to communicate to building users and build support for the system (for example, the water recycling system in Denver Water's Administration Building was named RUFUS: ReUse For Us)



Signage is required, but it is also an opportunity to engage occupants and visitors about conserving water with onsite water treatment systems.

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