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





San Francisco's Onsite Water Reuse System Projects

San Francisco Public Utilities Commission
September 2024

Single Building District Scale

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San Francisco's Onsite Water Reuse Program creates a regulatory framework and streamlined permitting process for commercial, multi-family, and mixed-use developments in San Francisco to collect, treat, and reuse alternate water sources for toilet flushing, irrigation, and other non-potable uses. In September 2012, the City and County of San Francisco adopted the Onsite Water Reuse for Commercial, Multi-Family, and Mixed-Use Development Ordinance. Commonly known as the Non-potable Water Ordinance (NPO), 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. Since 2012, the Non-potable Water Ordinance has been amended to allow for district-scale projects, where two or more parcels can share alternate water sources. In 2015, Article 12C became a mandatory requirement for new development projects of 250,000 square feet or more of gross floor area to install and operate an onsite water reuse 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 contains new requirements for different project types based on the required alternate water sources and non-potable end uses. New development projects of 100,000 gross square feet or more that submit a site permit after January 1, 2022 are required to install and operate an onsite water reuse system. 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. The requirements apply to both development projects consisting of a single building or multiple buildings. Additionally, new development projects of 40,000 gross square feet or more are required to submit water budget calculations assessing the supply available from the required alternate water sources and the demand from required non-potable uses, outlined in the table below. It is not required to install and operate an onsite water reuse system, but projects may choose to do so following the 10-step permitting process.

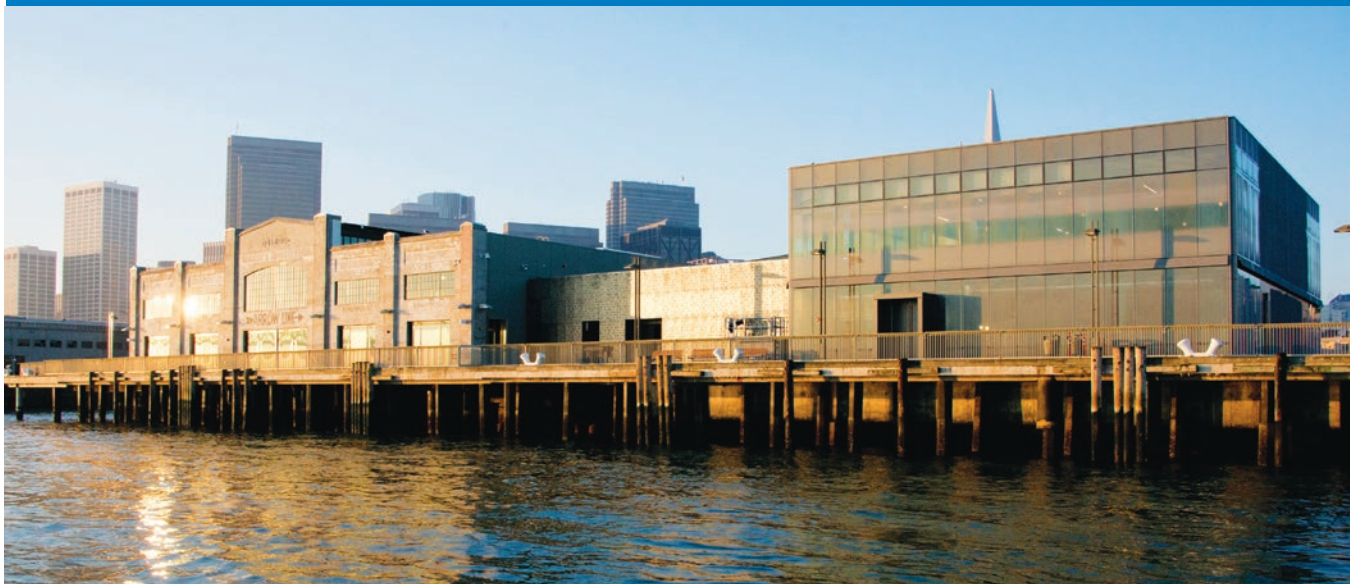
In dense, urban centers like San Francisco, the use of on-site alternate water sources is a key strategy for expanding potable water savings. Alternate sources of water that can be used in a non-potable water system are:

- **Rainwater** – precipitation collected from roofs or other manmade above grade surfaces
- **Stormwater** – precipitation collected from at or below grade surfaces
- **Graywater** – wastewater from bathroom sinks, showers, and washing machines
- **Blackwater** – graywater and wastewater from kitchen sinks and toilets
- **Foundation Drainage** – nuisance groundwater that floods basements
- **Condensate** – water vapor collected from air conditioning systems
- Other sources as approved by the San Francisco Department of Public Health (SFDPH)

San Francisco's Onsite Water Reuse System Program is a collaborative program involving four San Francisco agencies: San Francisco Public Utilities Commission (SFPUC), San Francisco Department of Public Health (SFDPH), San Francisco Public Works (SFPW), and San Francisco Department of Building Inspection (SFDBI). The SFPUC provides technical and financial assistance to assist developers through the processes for permitting, installing, and operating non-potable water systems. SFDPH regulates the water quality and monitoring requirements. SFDPH also issues operating permits and establishes reporting requirements for on-site treatment systems. SFPW reviews projects installing infrastructure in the public right-of-way (such as a sidewalk or street) for potential utility conflicts, and issues an encroachment permit. SFDBI oversees the design and construction of non-potable water systems, and issues final approvals for building occupancy. Each project proponent must ensure that the project is designed and installed safely, complies with applicable laws and regulations, and is operated in a manner that causes no harm or damage to building occupants or others.

This report details developments in San Francisco that are currently operating or are in the process of installing a non-potable water system. As more of these systems are installed in San Francisco, they will be added to this report. More information about San Francisco's Onsite Water Reuse System Program, including a developers guidebook, is available at: **https://sfpuc.org/construction-contracts/design-guidelines-standards/onsite-water-reuse**. If you have questions or need additional assistance, please email **nonpotable@sfwater.org**.

The Exploratorium — Pier 15



The Exploratorium at Pier 15 (image courtesy of Amy Snyder © Exploratorium, All rights reserved)

Project Status: Online

SFDPH Permit Issued: Yes. NPDES Permit received from Water Quality Control Board.

Size: 333,000 Square Feet

Alternate Water Sources:
- Rainwater
- Bay Water

End Uses:
- Toilet Flushing
- Heating and Cooling

Volume: Up to 2,364,000 Gallons/Year (Rainwater Harvesting System and Bay Water Heating and Cooling System)

Potable Water Use Reduction: 30% (Rainwater Harvesting System Only)

Driver(S): Project Sustainability Goals, Public Education, Leed Platinum Certification, and Mandate (San Francisco Stormwater Management Ordinance)

System Cost: Not Available

Annual O&M Cost: TBD

Owner: The Exploratorium

Project Description:

After spending 44 years at the Palace of Fine Arts, in April of 2013, the internationally renowned Exploratorium moved to its new 330,000 square feet of indoor and outdoor exhibit space on Pier 15. The LEED Platinum museum, host to over 1,000,000 visitors in its first year, houses more than 600 exhibits and experiences for guests to explore and tinker. The new location, literally on top of San Francisco Bay, is being called a twenty-first-century learning laboratory, and is equipped with oceanographic equipment, which measures the height and direction of tides, pollutants in the air, and the weather.

One of the core goals of the Exploratorium is sustainability. This goal is showcased throughout the museum, and has been validated with the building's LEED Platinum designation. A major goal the museum is working towards is to become the largest net-zero energy use museum in the United States. Water conservation is also a goal of the museum. In addition to the over 78,000 square feet of solar panels, the Exploratorium utilizes Bay water in its heating and cooling system, eliminating the need for a cooling tower, thereby saving an annual 2,000,000 gallons of water. To install the Bay water system, the Exploratorium had to obtain a National Pollutant Discharge Elimination System (NPDES) Permit from the local State of California Regional Water Quality Control Board to ensure that the system would not negatively impact the aquatic life and water quality of

the Bay. The Exploratorium also has to provide annual reports to the State to show compliance with their NPDES permit requirements.

The Exploratorium also has a 38,600-gallon cistern, which captures rainwater from the roof for toilet flushing purposes. The rainwater harvesting system can save up to 364,000 gallons annually, reducing water usage by approximately 30% in a year of average rainfall. Finally, the building is equipped with high- efficiency dual-flush toilets, waterless urinals, and low-flow sensor-operated faucets— reducing water consumption by another 30%.

Drivers for Non-potable Water Reuse:

From the beginning of the design stages for the Exploratorium, two primary objectives were to have a building that demonstrated the museum's ambitious sustainability goals and served as a localized example of how buildings can be built in response to climate change. Incorporating the Bay water heating and cooling system and the rainwater harvesting system helped to achieve these objectives.

Implementing the onsite water systems also allowed the Exploratorium to obtain additional LEED points to help the project achieve LEED Platinum certification. The project received an additional six Water Efficiency (WE) points and two Regional Priority (RP) points by implementing the systems.

Finally, the rainwater harvesting system also allows the Exploratorium to fulfill the requirements of the San Francisco Stormwater Management Ordinance. The Stormwater Management Ordinance requires projects disturbing 5,000 square feet or more of the ground surface to decrease the project's post-construction stormwater runoff rate and volume by 25% for the 2-year 24-hour design storm.

Ownership Model:

The Bay water cooling and heating system and rainwater harvesting system are owned, operated, and maintained by the Exploratorium.

Project Cost:

The new Exploratorium cost $220 million to build. The specific costs for the Bay water cooling and heating system cost and the rainwater harvesting system are not available. The NPDES permit from the Regional Water Quality Control Board for the Bay water heating and cooling system cost $1,943 in 2011.

Annual Operations & Maintenance Cost:

TBD

Service Costs to Residents or Tenants:

Not applicable

Reference:

Jennifer Fragomeni, The Exploratorium (**jfragomeni@exploratorium.edu**)

Inside the Bay heating and cooling room at the Exploratorium (image courtesy of Amy Snyder © Exploratorium, All rights reserved)

Whole Foods Mixed-use Development — 38 Dolores Street

38 Dolores Street (image courtesy of BAR Architects)

Project Status: Online

SFDPH Permit Issued: N/A
(A Rainwater Harvesting Project for Non-Spray Irrigation Does Not Need a Permit)

Size: 195,000 Square Feet

Alternate Water Sources:
- Rainwater

End Uses:
- Subsurface Irrigation
- Drip Irrigation

Volume: 26,000 Gallons/Year

Potable Water Use Reduction:
26% for Irrigation; 1.3% Total Project Reduction

Driver(S): Leed Points, Sustainable Sites Pilot Project Certification, and Mandate (San Francisco Stormwater Management Ordinance)

System Cost: Not Available

Annual O&M Cost: Negligible

Owner: The Prado Group (Market Dolores LLC)

Project Description:

In fall 2013, the Prado Group (Market Dolores LLC) completed construction on a new 195,000 square-foot mixed-use development containing 81 residential rental units and a 30,000 square-foot Whole Foods grocery store on the ground level. Targeted for LEED Gold, the development – located between Market Street, Dolores Street, and 14th Street – contains a 16,200 gallon cistern that collects rainwater from all rooftop surfaces (traditional roofs, green roof, and flow-through planters). The harvested rainwater is used to irrigate all landscaping within the development via subsurface and drip irrigation systems. The cistern is sized to hold the required average annual detention volume associated with the San Francisco Stormwater Management Ordinance design storm event, while also taking into consideration the project's monthly irrigation demand. The project will offset an estimated 26,000 gallons of potable water annually.

The project does not have a permit from the San Francisco Department of Public Health because rainwater systems that, at a minimum, include both a first flush diverter and a 100 micron filter, and are used for subsurface irrigation, drip irrigation, or non-spray surface irrigation, do not need one.

Drivers for Non-potable Water Reuse:

The project team installed the rainwater harvesting system to meet the requirements of the San Francisco Stormwater Management Ordinance. The Stormwater Management Ordinance requires projects disturbing 5,000 square feet or more of the ground surface to decrease the project's post-construction stormwater runoff rate and volume by 25% for the 2-year 24-hour design storm. Installing a rainwater harvesting system with a 16,200 gallon cistern enabled the project to meet these requirements.

The project also installed the rainwater harvesting system to obtain LEED points to help the project achieve LEED Gold Certification. Additionally, the project was designed and certified as a Sustainable SITES Pilot Project, which also was a driver for installing the system. Sustainable SITES certification is given to projects that use sustainable practices that enable built landscapes to support natural ecological functions by protecting existing ecosystems and regenerating ecological capacity where it has been lost.

Ownership Model:

The rainwater harvesting system is owned, operated, and maintained by the Prado Group (Market Dolores LLC), which owns the development and leases the commercial spaces and residential units to tenants.

Project Cost:

The total hard cost for the project was $48 million. The contractor did not break out the cost of the rainwater harvesting system as a discrete item.

Annual Operations & Maintenance Cost:

The cost to operate and maintain the rainwater harvesting system is negligible.

Service Costs to Residents or Tenants:

There are no service costs to the commercial or residential tenants for use of the rainwater.

Reference:

Jon Yolles, The Prado Group (jyolles@pradogroup.com); Eric Girod, BKF Engineers (egirod@bkf.com)

38 Dolores Street (image courtesy of BAR Architects)

James R. Herman Cruise Terminal — Pier 27

The James R. Herman Cruise Terminal at Pier 27 (image courtesy of San Francisco Public Works)

Project Status: Online

SFDPH Permit Issued: Yes

Size: 88,000 Square Feet

Alternate Water Sources:
- Rainwater

End Uses:
- Toilet Flushing
- Irrigation

Volume: 370,000 Gallons/Year

Potable Water Use Reduction: 50%

Driver(S): LEED Certification and Mandate (San Francisco Stormwater Management Ordinance)

System Cost: $930,000

Annual O&M Cost: $38,000

Owner:
The Port of San Francisco

Project Description:

On September 18, 2014, the James R. Herman Cruise Terminal – located at Pier 27 – opened its doors for business. The approximately 88,000 square foot, two-level cruise terminal facility, is located in the heart of The City right under Telegraph Hill, with San Francisco's famous sights within walking distance. The modern terminal, designed to accommodate ships with up to 4,000 passengers, has all the functions and amenities a cruise ship might want. The terminal also includes a 2.3-acre raised plaza with grass and benches intended as a respite for visitors and residents alike.

A core objective of the James R. Herman Cruise Terminal design team was the integration of sustainable technologies in the project. The project was constructed using sustainable design practices in accord with Leadership in Energy & Environmental Design (LEED) standards. The terminal achieved LEED Silver certification due to all of its sustainable initiatives. The following are just some of the sustainable features of the terminal:

- Indoor plumbing fixtures operate 40% more efficient than existing code;
- Landscape design resulted in more than 50% irrigation reduction compared to a mid-summer baseline;
- Energy efficient building envelope, lighting, and HVAC systems reduce energy needs by more than 18% compared to a mid-summer baseline;

- Building materials composed heavily of recycled, regional, and Forest Stewardship Council certified wood; and
- A construction process which diverted more than 75% of construction waste materials from landfill.

The terminal also includes a rainwater harvesting system. Rainwater from the roof is sent to a pre-filtration system, removing larger debris, before the collected rainwater drains to a five-tank, 42,000-gal rainwater harvesting system. The five cisterns are able to capture over 75% of the annual rainfall that hits the roof surface. The captured rainwater is used for toilet flushing in the main terminal, and also for outdoor irrigation of the facility's gardens. However, before being used, the rainwater must undergo treatment. When there are toilet flushing and irrigation demands, rainwater is pumped from the cisterns through a filtration and ozone disinfection treatment system before entering dedicated plumbing lines to the toilets and irrigation zones. A digital rainwater control station houses all of the filters, treatment equipment, and controls.

The innovative rainwater harvesting system installed at the terminal saves approximately 370,000 gallons of potable water per year. The harvested rainwater covers roughly 70% of the terminal's total non-potable demand, reducing the terminals overall water use by nearly 50%.

Drivers for Non-potable Water Reuse:

Implementing the rainwater harvesting system allowed the terminal to obtain additional LEED points to help the project achieve LEED Silver certification. The project received an additional six Water Efficiency (WE) points and two Regional Priority (RP) points by implementing the systems.

Additionally, the rainwater harvesting system also allows the terminal to fulfill the requirements of the San Francisco Stormwater Management Ordinance. The Stormwater Management Ordinance requires projects disturbing 5,000 square feet or more of the ground surface to decrease the project's post-construction stormwater runoff rate and volume by 25% for the 2-year 24-hour design storm.

Ownership Model:

The rainwater harvesting system is owned by The Port of San Francisco who has hired Metro Cruise Services to operate and maintain the system.

Project Cost:

The James R. Herman Cruise Terminal cost $93 million to build. The rainwater harvesting system cost $930,000. These systems increased total construction costs by 1%.

Annual Operations & Maintenance Cost:

Maintaining the rainwater system has an annual cost of $38,000.

Service Costs to Residents or Tenants:

Not applicable

Reference:

Lucas Yee, San Francisco Public Works
(Lucas.Yee@sfdpw.org)

The rainwater cisterns at Pier 27 (image courtesy of San Francisco Public Works)

Vera Haile Senior Housing & St. Anthony's Foundation Dining Room & Social Work Center — 121/129 Golden Gate Avenue

The Vera Haile Housing and St Anthony's Foundation Dining Room and Social Work Center (image courtesy of David Wakely Photography)

Project Status: Online

SFDPH Permit Issued: Yes

Size: 110,000 Square Feet

Alternate Water Sources:

- Rainwater

End Uses:

- Toilet Flushing

Volume: 37,000 Gallons/Year

Potable Water Use Reduction: 8%

Driver(S): Mandate (San Francisco Stormwater Management Ordinance)

System Cost: $400,000

Annual O&M Cost: $2,500

Owner: Mercy Housing California (MHC) and The St. Anthony Foundation (SAF)

Project Description:

Nestled between the Civic Center and Tenderloin neighborhoods, 121 and 129 Golden Gate Avenue is a ten-story building housing Vera Haile Senior Housing and the St. Anthony's Dining Room and Social Work Center. St. Anthony's Dining Room is the only meal program in San Francisco that serves people 365 days a year. Situated on the first floor, the Dining Room serves 3,000 free meals a day and provides a place for people to socialize and find support, as more than 80% of their guests live alone. On the second floor, the building also houses St. Anthony Foundation's Social Work Center and Free Clothing Program serving the wider community. From floors three through ten, Vera Haile Senior Housing provides affordable apartments for low-income seniors ages 62 and older. There are 90 units in the building, comprised of studios and one-bedroom units that are include with full kitchens and access to internet, cable, and telephone.

This 110,000 square foot building has several sustainability measures, including a solar thermal heating system, hydronic heating system, cool roofing

and high-reflectivity paving, low/no VOC sealants, and an energy efficient envelope and windows. It also has a rainwater harvesting system that will collect water from the roof into a 4,400 gallon cistern for storage. The rainwater is then treated onsite and pumped into restrooms within the Dining Room to flush toilets and urinals. With an average of 1000 Dining Room guests per day, it is estimated that demand for water in the Dining Room restrooms will match the volume of water collected in a normal wet season.

Drivers for Non-potable Water Reuse:

In order to meet the requirements of the San Francisco Stormwater Management Ordinance, the project team installed the rain harvesting system. The Stormwater Management Ordinance requires projects that disturb 5,000 square feet or more to decrease the project's post-construction stormwater runoff rate and volume by 25% for the 2-year 24-hour design storm. Installing a rainwater harvesting system with a 4,400 gallon cistern enables the project to meet these requirements.

Ownership Model:

Mercy Housing California and the St. Anthony's Foundation each own certain air rights parcels that are within the building. Mercy Housing California owns an air rights parcel that includes floors 3-10 and the part of the basement where the cistern, stormwater collection, storage , and the water treatment system are housed. St. Anthony's owns an air rights parcel that includes Floors 1-2. They stormwater distribution system is partially in both air rights parcels.

Project Cost:

The cost for the rain harvesting system is $400,000. $69 million is the total hard cost for the project ($42 million for the Vera Haile portion and $17 million for the St. Anthony's portion).

Annual Operations & Maintenance Cost:

The license and testing requirements are approximately $2,500/annually. The project is budgeting $3,500 annually for maintenance.

Service Costs to Residents or Tenants:

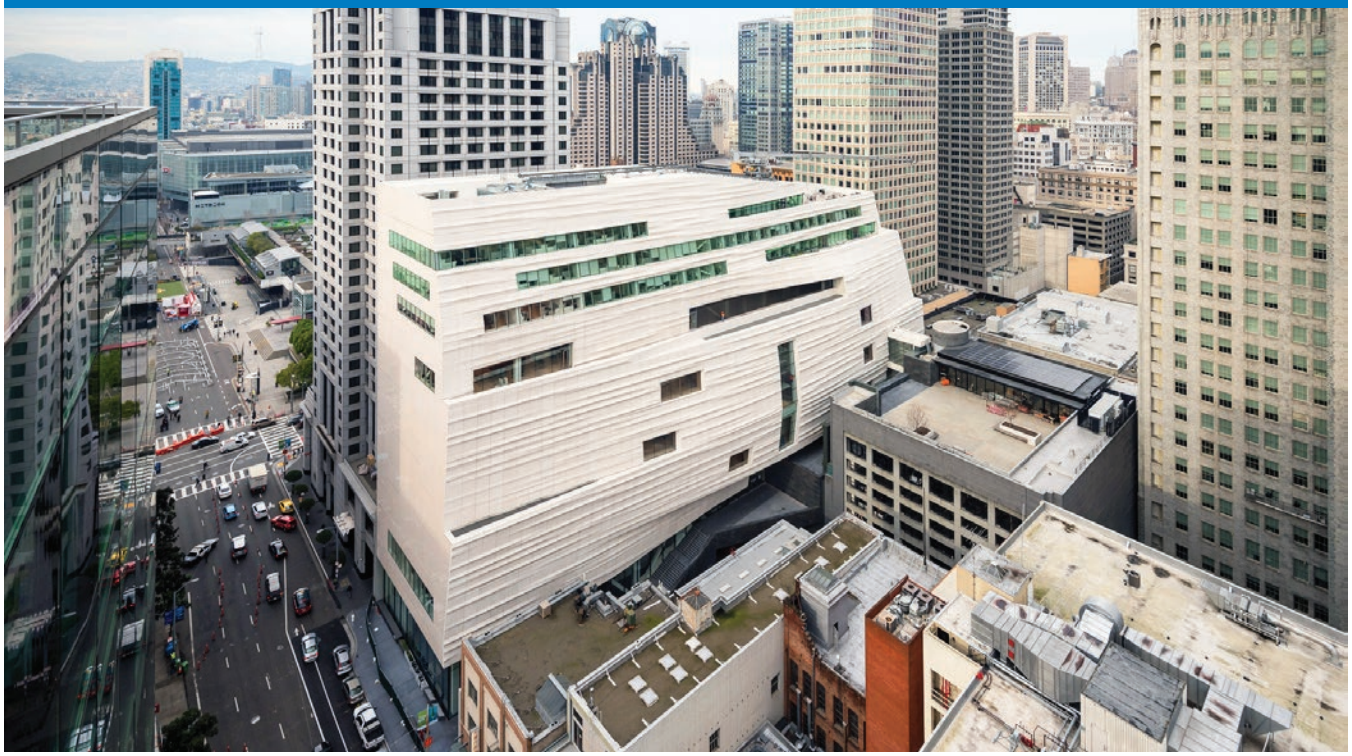
Not applicable.

Reference:

Sharon Christen, Mercy Housing California (schristen@mercyhousing.org)

The Vera Haile Housing and St Anthony's Foundation Dining Room and Social Work Center (image courtesy of David Wakely Photography)

San Francisco Museum of Modern Art — 151 Third Street



The San Francisco Museum of Modern Art (image courtesy of Snohetta)

Project Status: Online

SFDPH Permit Issued: Yes

Size: 235,000 Square Feet

Alternate Water Source:
- Rainwater

End Uses:
- Toilet/Urinal Flushing
- Irrigation
- Cooling Tower Make-Up

Volume: 1,000 GPD; 365,000 Gallons/Year

Potable Water Use Reduction: TBD

Drivers: Sustainability Goals, Reduce Potable Water Use, and Compliance with San Francisco Stormwater Management Ordinance

System Cost: Not Available

Annual O&M Cost: Not Available

Owner:
San Francisco Museum of Modern Art

Project Description:

The San Francisco Museum of Modern Art (SFMOMA) is a world-renowned modern art museum, showcasing over 33,000 pieces of modern and contemporary art. After a three year expansion project, SFMOMA opened to the public in May 2016 with nearly triple the gallery space, free public spaces, free admission for all visitors 18 and under and enhanced educational programs.
In addition to the new, ultra-modern architectural design, SFMOMA incorporated sustainable elements throughout the museum such as garden terraces and a living wall. SFMOMA's commitment to sustainability is also evident through the implementation of its non-potable water reuse system. The non-potable system captures rainwater for reuse in the building. The captured water is treated by a filter assembly including a 50 micron filtration filter and a 20 micron bag type filter. After treatment, the water is disinfected and distributed for non-potable applications, which includes toilet flushing, make-up water for the cooling towers, and drip irrigation of the gardens and living wall. Overall, the system is saving 365,000 gallons of potable water annually, equating to roughly 1,000 gallons of water per day.

Drivers for Non-potable Water Reuse:

SFMOMA is building on its tradition of innovation through the implementation of the onsite water system. By harvesting rainwater, the building is offsetting a significant amount of potable water needed for toilet flushing, irrigation, and cooling tower operation. Secondly, the integration of the onsite water system enables SFMOMA's expansion project to meet the requirements of San Francisco's Stormwater Management Ordinance. The Stormwater Management Ordinance requires projects disturbing 5,000 square feet or more of ground surface to decrease their post construction stormwater runoff rate and volume by 25% for the 2-year, 24-hour design storm.

Ownership Model:

The rainwater reuse system is owned, operated, and maintained by the SFMOMA.

Project Cost:

The estimated cost of onsite water system is not available.

Annual Operations & Maintenance Cost:

The estimated annual cost to operate and maintain the onsite water system is not available.

Service Costs to Residents or Tenants:

Not Applicable

Incentives provided by SFPUC:

Not Applicable

Reference:

Bob Reuter, Reuter Project Management
(reuter@ix.netcom.com)

The San Francisco Museum of Modern Art's onsite water system (image courtesy of Bob Reuter)

Market Street Place — 945 Market Street

Market Street Place (image courtesy of CRP/Cypress Market Street, LLC)

Project Status: Online

SFDPH Permit Issued: Yes

Size: 283,940 Square Feet with 91,870 Square Feet of Sub-Grade Parking.

Alternate Water Sources:
- Rainwater

End Uses:
- Toilet Flushing
- Cooling Tower Make-Up

Volume: 446,000 Gallons/Year

Potable Water Use Reduction: 12%

Driver(S): LEED Points and Mandate (San Francisco Stormwater Management Ordinance)

System Cost: TBD

Annual O&M Cost: TBD

Owner: CRP/Cypress Market Street LLC

Project Description:

The 283,940 square-foot Market Street Place, scheduled to open in 2016, is a six-level retail center with 91,870 square feet of subgrade parking located at 945 Market Street. Situated between 5th and 6th Streets, the center contains an 18,300 gallon cistern which collects rainwater from a 48,000 square-foot roof. The cistern is sized to hold the required average annual detention volume associated with the San Francisco Stormwater Management Ordinance design storm event. Treatment for the rainwater is provided by a Water Control Corporation RW-Series Skid Mounted Water Reclamation Packaged System consisting of 25 and 5 micron filtration followed by ultraviolet (UV) disinfection. After treatment and disinfection, the harvested rainwater is used for cooling tower make-up and to flush 54 toilets and 18 urinals. The system offsets an estimated 446,000 gallons of potable water annually, reducing the project's potable water use by approximately 12%.

Drivers for Non-potable Water Reuse:

The project team installed the rainwater harvesting system to obtain the LEED innovation in design credit of 40% potable water use reduction.

The project team also installed the rainwater harvesting system to meet the requirements of the San Francisco Stormwater Management Ordinance. The Stormwater Management Ordinance requires projects disturbing 5,000 square feet or more of the ground surface to decrease the project's post-construction stormwater runoff rate and volume by 25% for the 2-year 24-hour design storm. Installing a rainwater harvesting system with an 18,300 gallon cistern enables the project to meet these requirements.

Ownership Model:

The rainwater harvesting system is owned by CRP/ Cypress Market Street LLC, who will contract a building management firm for operation. The contracted building operator will operate and maintain the system.

Project Cost: TBD

Annual Operations & Maintenance Cost: TBD

Service Costs to Residents or Tenants:

There are no service costs to the commercial tenants for use of the rainwater.

Reference:

Phillip Alexander, Randall Lamb (PAlexander@RandallLamb.com); and Kathy Kwong, Gensler (Kathy_Kwong@Gensler.com)

Market Street Place (image courtesy of CRP/Cypress Market Street, LLC)

Bill Sorro Community - Affordable Housing Project — 200 6th Street

The Bill Sorro Community (image courtesy of Kennerly Architecture)

Project Status: Online

SFDPH Permit Issued: Yes

Size: 69,000 Square Feet

Alternate Water Sources:
- Rainwater

End Uses:
- Toilet Flushing

Volume: 45,000 Gallons/Year

Potable Water Use Reduction: 10%

Driver(S): Project Sustainability Goals and Mandate (San Francisco Stormwater Management Ordinance)

System Cost: $280,000 (Estimated)

Annual O&M Cost: TBD

Owner: Mercy Housing California

Project Description:

Located in the South of Market neighborhood in San Francisco, the 69,000 square-foot Bill Sorro Community, is a 100% affordable housing development. The project demolished an existing building in favor of a nine-story, 85 foot tower with 67 affordable family apartments, restaurant, retail, and community space. The project installed a 3,000 gallon cistern to collect rainwater from an 8,800 square-foot roof. The cistern is sized to hold the required average annual detention volume associated with the San Francisco Stormwater Management Ordinance design storm event. Treatment for the rainwater consists of particulate filters to remove the suspended solids and ultraviolet (UV) disinfection prior to being distributed throughout the building for toilet flushing purposes. The system offsets an estimated 45,000 gallons of potable water annually, reducing the project's potable water use by approximately 10%.

The project is also located in a designated recycled water use area under San Francisco's Recycled Water Use Ordinance, and therefore is plumbed to be ready for the eventual use of SFPUC recycled water for toilet flushing when rainwater is not available.

Drivers for Non-potable Water Reuse:

The project team installed the rainwater harvesting system to meet the requirements of the San Francisco Stormwater Management Ordinance. The Stormwater Management Ordinance requires projects disturbing 5,000 square feet or more of the ground surface to decrease the project's post-construction stormwater runoff rate and volume by 25% for the 2-year 24-hour design storm. Installing a rainwater harvesting system with a 3,000 gallon cistern enables the project to meet these requirements. Another driver for implementing the rainwater harvesting system is to meet project sustainability goals, include exceeding the San Francisco Green Building Ordinance GreenPoint Rated system for multi-family buildings.

Ownership Model:

Mercy Housing California (MHC) is the owner/developer of the Bill Sorro Community. The City and County of San Francisco owns the land under the building, so there is a ground lease for the land with the City and County of San Francisco. MHC assigned staff with the appropriate backgrounds from their maintenance team to be responsible for operating and maintaining the rainwater harvesting system. Maintenance staff are trained by the system manufacturer at the completion of the construction for continued operation and maintenance. The basic operations, inspection schedule, and routine preventative maintenance of the non-potable rainwater collection system were covered during this initial training.

Project Cost:

The total cost for the rainwater harvesting system is estimated to be approximately $280,000.

Annual Operations & Maintenance Cost:

TBD

Service Costs to Residents or Tenants:

There are no service costs to the tenants for the use of the rainwater.

Reference:

Sharon Christen, Mercy Housing California
(schristen@mercyhousing.org)

The Bill Sorro Community (image courtesty of Kennerly Architecture)

181 Fremont Mixed-use Tower — 181 Fremont Street

The 181 Fremont Mixed-use Tower (image courtesy of Jay Paul Company and Heller Manus Architects)

Project Status: Online

SFDPH Permit Issued: Yes

Size: 706,617 Square Feet

Alternate Water Sources:

- Graywater
- Rainwater

End Uses:

- Toilet Flushing
- Irrigation

Volume: 5,000 GPD; 1,300,000 Gallons/ Year

Potable Water Use Reduction: 21%

Driver(S): Sustainability Goals, LEED Points,
and Mandate (San Francisco Stormwater Management Ordinance)

System Cost: TBD

Annual O&M Cost: TBD

Owner: 181 Fremont Street LLC

Project Description:

The 70-story, 706,617 square foot, 181 Fremont Mixed-use Tower is a world-class example of modern design and sustainability in a high-rise project. The Tower, which is over 800 feet tall, features 435,000 square feet of class-A office space and 67 condominium residences on the top floors. Targeted for LEED Platinum, the development – located immediately adjacent to the future Transbay Transit Center – contains several sustainable features such as a 238-stall bike barn, a comprehensive transportation plan, regionally sourced building materials, and a comprehensive lighting design that increases access to the night sky and reduces urban sky glow.

The Tower also includes an onsite water system which captures, treats, and reuses graywater and rainwater. Graywater is collected from the condos (showers, laundry and bathroom sinks) and commercial office floors (bathroom sinks), while rainwater is captured from the roof of the building. The captured graywater is treated in an Aquacell system in the lowest basement level of the building. The self-contained treatment system is based on membrane bioreactor technology, a widely employed treatment technology for onsite systems. The system is ideal for the project because of its small footprint, tight quality controls, high yield and consistent production of high quality treated water. The onsite graywater system will provide up to 5,000 gallons per day of recycled water for toilet and urinal flushing and irrigation, saving annually up to 1.3 million gallons of potable water. Rainwater is

treated in a PHOENIX Rainwater Treatment System, then combined with the treated graywater for the final stage of disinfection. The two sources utilize different process treatment trains by design, however the systems are integrated, offering a central control interface and providing the building with a single supply of highly treated recycled water.

Drivers for Non-potable Water Reuse:

From the beginning of the design stages, a primary objective of the Tower was to showcase ambitious sustainability measures in an ultra-modern design. The Tower serves as a localized example of how buildings can achieve multiple aesthetic and sustainability goals. Implementing the onsite water system also allows the Tower to obtain additional LEED points towards LEED Platinum certification. The project received an additional six Water Efficiency (WE) points and two Regional Priority (RP) points by implementing the system. Additionally, by integrating rainwater into the non-potable water system, the Tower is able to fulfill the requirements of the San Francisco Stormwater Management Ordinance. The Stormwater Management Ordinance requires projects disturbing 5,000 square feet or more of the ground surface to decrease the project's post-construction stormwater runoff rate and volume by 25% for the 2-year 24-hour design storm.

Ownership Model:

While the onsite water system is owned by 181 Fremont Street LLC, system design, permitting, installation supervision, commissioning, and operations is the responsibility of PHOENIX Process Equipment Co. (via joint-venture with Aquacell).

Project Cost: TBD

Annual Operations & Maintenance Cost:

TBD

Service Costs to Residents or Tenants:

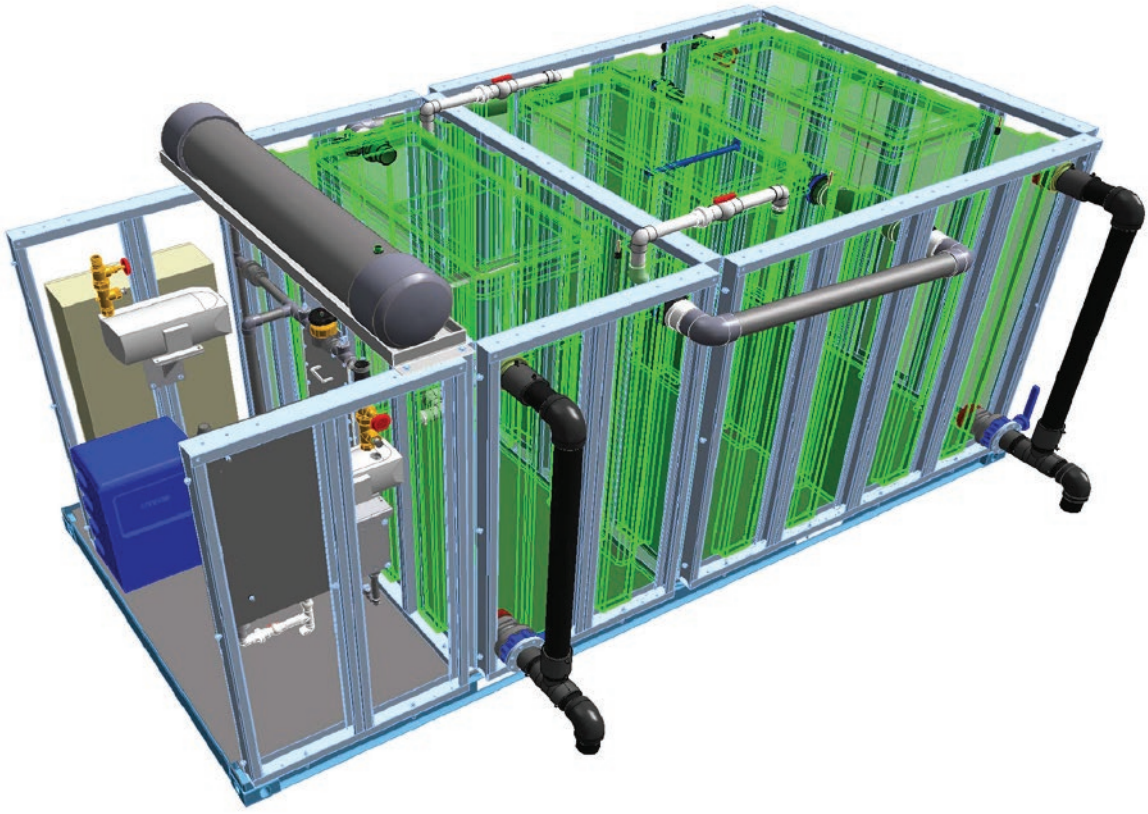
TBD

Incentives provided by SFPUC:

The 181 Fremont Tower received a $250,000 grant from the SFPUC through the Onsite Water Reuse Grant Program.

Reference:

Ben Arnold, PHOENIX/Aquacell
(bena@aquacell.us)



A rendering of the treatment system at 181 Fremont Mixed-use Tower (image courtesy of PHOENIX/Aquacell)

San Francisco Permit Center at 49 South Van Ness Avenue – San Francisco, CA

Rendering of 49 South Van Ness (image courtesy of SOM)

Project Status: Completed

Project Size: 523,800 Square Feet

Alternate Water Sources:
- Rainwater
- Graywater

End Uses:
- Toilet/Urinal Flushing
- Subsurface Irrigation

Treatment System Size: 5,000 Gallons/Day

Potable Water Use Reduction:
17%; 482,000 Gallons/Year

Drivers: Non-potable Water Ordinance Compliance

System Cost: $400,000

Annual O&M Cost: $50,000

Owner: Related California

Project Description:

The new 16-story Permit Center provides office space for 1,800 city employees and is home to San Francisco's Public Works, Planning, and Building Inspections, and other city departments, consolidating all the City's permitting agencies into one space.

Graywater is collected from showers and lavatory faucets in the building and routed to a collection tank in the plant room. Rainwater is also collected from the building's rooftop, which is directed into a separate collection tank. The graywater passes through a 130-micron filter and then undergoes a biological treatment process before it enters a break tank, while rainwater is pumped directly from its collection tank into the break tank. From the break tank, the mixture of rainwater and filtered graywater is pumped through the treatment skid for further filtration, UV disinfection, and chlorine dosing to maintain a residual in the treated water storage tank. Non-potable water in the treated storage tank is used to supply the toilets, urinals, and irrigation needs. Potable water make-up will be supplied to the tank, with an air gap for backflow prevention, if the alternative water supply is too low to meet the demands.

Drivers for Onsite Water Reuse:

Based on its size, the project is required to comply with the Non-Potable Ordinance.

Ownership Model:

Related California is the owner of the water reuse system. The contract for the service and maintenance of the system has not yet been awarded.

Project Cost and Funding: The total project cost is unavailable, but the reuse system cost approximately $400,000 plus installation.

Lessons Learned:

There is immeasurable value in equipping contractors with as much knowledge as possible prior to the installation of an onsite water reuse system, and it is best to assume that contractors "don't know what they don't know" when it comes to installation. The instructional drawings and documents provided with reuse systems are detailed and can be intimidating, and contractors have always been appreciative of extra time spent explaining the installation process.

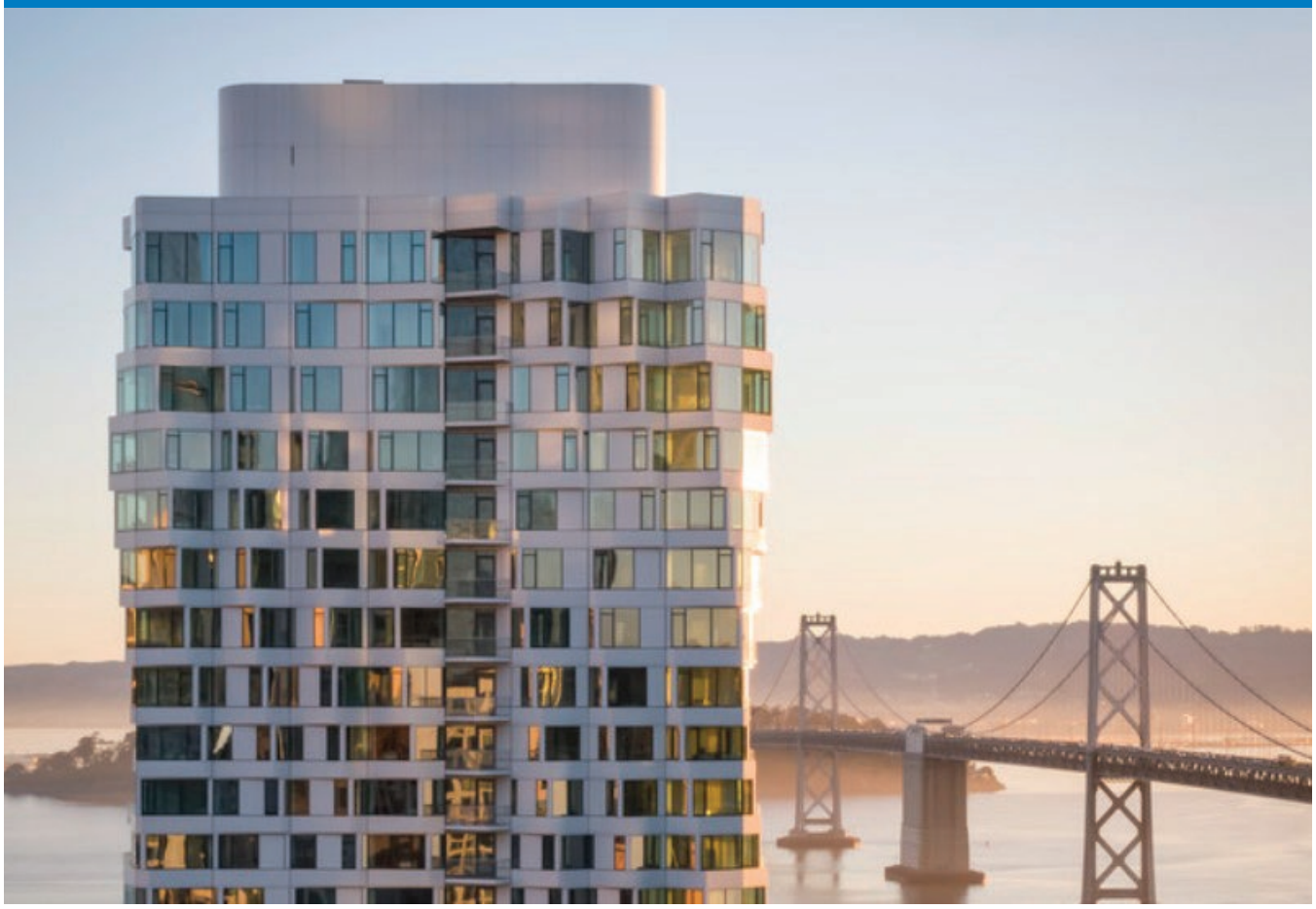
Aquacell treatment systems are manufactured to minimize the effort required to install them, saving time and money. The treatment skids are delivered to the site with the bulk of the plumbing & electrical work already completed. A pre-installation meeting with the contractor, with time spent explaining the sequence of installation, can aid the process.

Reference:

David Guan, Cal Pacific Systems
(David.guan@calpacificsystems.com),
415-252-8600

Onsite reuse system treatment skid at 49 South Van Ness (image courtesy of Aquacell)

Mira at 160 Folsom Street – San Francisco, CA



MIRA tower (image courtesy of Aquacell by PHOENIX)

Project Status: Online

Project Size: 698,644 square feet

Alternate Water Sources:
- Rainwater
- Graywater

End Uses:
- Toilet/Urinal Flushing
- Subsurface Irrigation

Treatment System Size: 5,000 Gallons/Day

Potable Water Use Reduction: 14%; 1,900,000 Gallons/Year

Drivers: Sustainability, LEED Certification, Non-potable Water Ordinance Compliance

System Cost: $500,000

Annual O&M Cost: $50,000

Owner: Tishman Speyer Development, LLC.

Project Description:

This striking 400-foot mixed-use high-rise tower, containing 392 residential units and 5 ground level retailers, was designed to be a vertical neighborhood in the transbay area of San Francisco. Along with the 40-story tower the complex consists of an 8-story mid-rise tower, a collection of 4-story townhomes, 3 levels of below grade parking, and a 2nd level residential courtyard. The twisting shape of the tower provides shade for residents and breaks up the flat, reflective glass exterior that can confuse birds.

The onsite water reuse system captures roof and terrace level rainwater along with graywater from sinks, showers, and washing machines, which is then treated and reused for toilet/urinal flushing within the buildings and irrigation of site landscaping, both within the parcel and in the surrounding right-of-

way. The rainwater harvesting tank and the graywater collection tank feed through an Aquacell G20 water treatment system to a treated water tank, from which non-potable water is distributed out to the site.

Drivers for Onsite Water Reuse:

This project implemented an onsite reuse system to comply with San Francisco's Non-potable Water Ordinance. In addition, Tishman Speyer included the onsite reuse system to align with their sustainability objectives for the project.

Ownership Model:

The onsite reuse system is owned by Tishman Speyer, and the building's Master Homeowners Association contracts the service and maintenance of the system to Aquacell.

Project Cost and Funding:

The total cost of the development was around $195 million, and the construction cost of the Aquacell water reuse system was approximately $500,000. It was installed as part of the construction of the tower and put into service once the building became occupied.

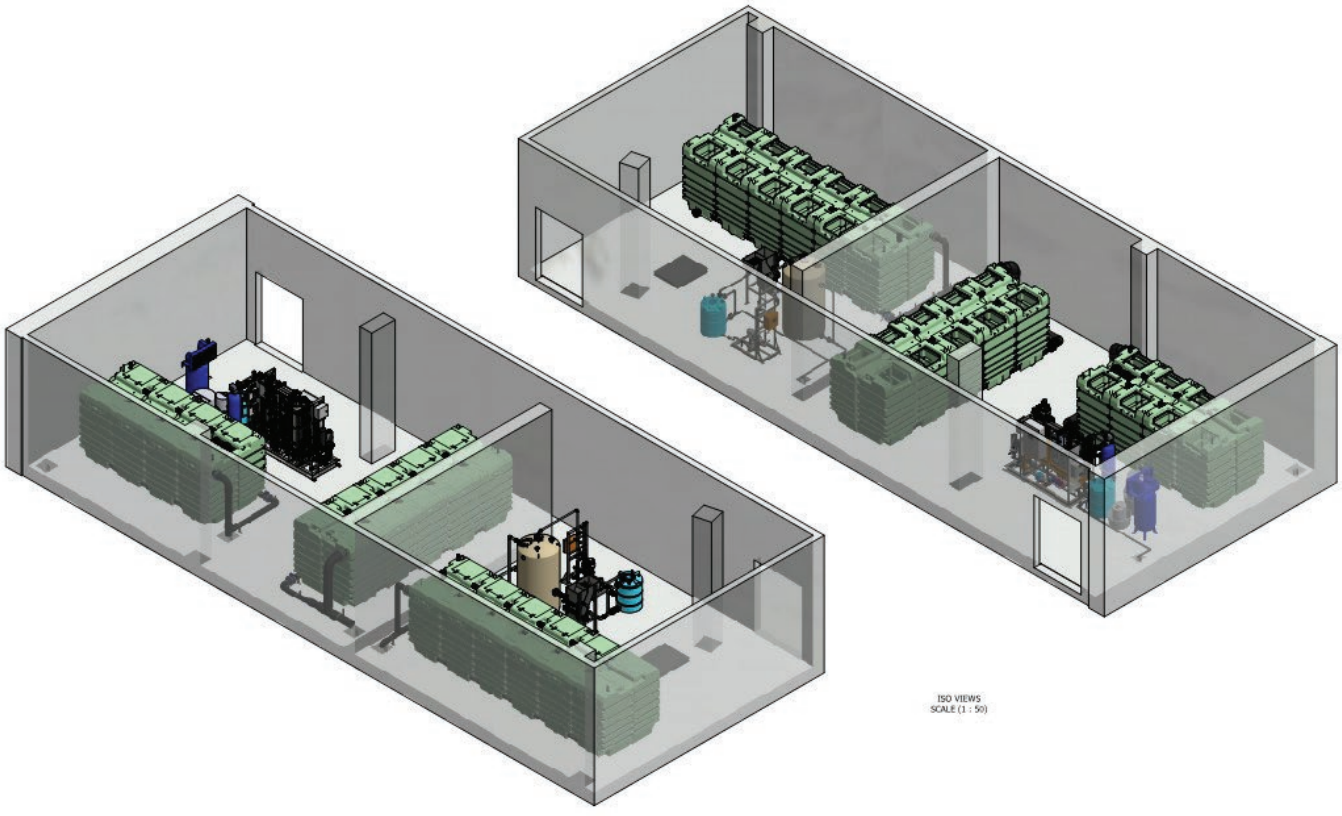
Lessons Learned:

Communication is key to the success of any installation. At the time of construction, contractors were not familiar with Alternate Water Source Systems. Time spent with the installing contractors both before and during the installation process was vital to a smooth and efficient installation.

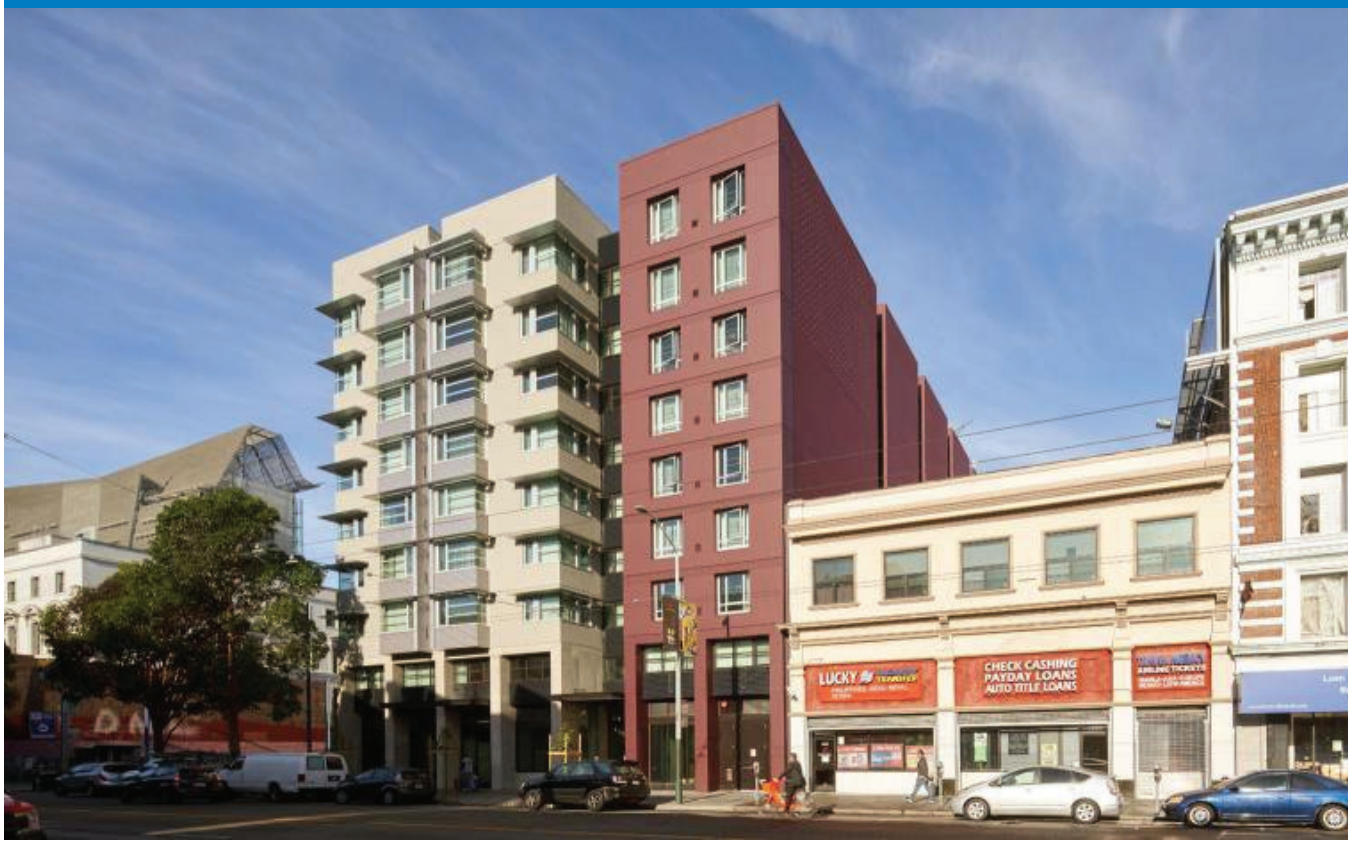
Reference:

Ben Arnold, Aquacell by PHOENIX,
(bena@dewater.com), 502-499-6198 xt. 146

A rendering of the treatment system at MIRA (image courtesy of Aquacell by PHOENIX)



Mission Street Family Housing at 1036 Mission Street – San Francisco, CA



1036 Mission Street (photo by Bruce Damonte)

Project Status: Online

Project Size: 97,171 square feet

Alternate Water Source:
- Rainwater

End Uses:
- Toilet/Urinal Flushing

Treatment System Size: 200 Gallons/Day

Potable Water Use Reduction:
3%; 90,500 Gallons/Year

Drivers: Stormwater Management

System Construction Cost: $600,000 to $700,000 for all costs (design through construction)

Annual O&M Cost: $20,000

Owner: 1036 Mission Associates LP C/O TNDC

Project Description:

This affordable housing residential building in the heart of San Francisco's SOMA neighborhood includes three 9-story sections that surround a 2nd-story roof courtyard on the west side of the building, with retail units on the first floor. It includes a combination of one, two, and three-bedroom units and a roof garden for resident use. It won a Pacific Coast Builders Gold Nugget Award of Merit for Best Affordable Housing in 2019.

Rainwater collected from the building's roof is reused to flush residential toilets. Prior to entering the cistern, harvested rainwater goes through a prescreen and an Aquacell treatment system consisting of disc filtration, GAC filtration, bag filtration, UV disinfection, and chlorination. When the rainwater harvesting cistern is empty, the cistern will retain a reserve level to serve non-potable water demands, which is supplemented with potable water.

Drivers for Onsite Water Reuse:

Given the small size and urban infill nature of the site, a rainwater reuse system was the best way to meet stormwater management requirements at the site.

Ownership Model:

TNDC/1036 Mission Associates LP owns the water reuse system and contracts the service and maintenance of the system to Aquacell.

Project Cost and Funding:

The total cost of the development was around $30 million, and the cost of the Aquacell water reuse system was approximately $600,000 to $700,000 including all building-related costs for the infrastructure, design, permitting, etc. The overall project was financed through public funding (San Francisco Mayors Office of Housing and Community Development permanent funding, State of California Housing and Community Development permanent funding), equity from 4% low income housing tax credits, and a grant from the Federal Home Loan Bank Affordable Housing Program. Additionally, construction period financing was provided through tax-exempt bonds issued by the City and County of San Francisco.

Lessons Learned:

San Francisco is a challenging location to recycle only rainwater. With its seasonal rainfall pattern, the system only operates 4 to 5 months a year. To offset as much potable demand as possible, the water supply could be expanded to include year-round sources such as graywater and/or blackwater.

Reference:

Ben Arnold, Aquacell by PHOENIX,
(bena@dewater.com), 502-499-6198 xt. 146

Rainwater harvesting system at 1036 Mission

Chorus at 30 Otis Street – San Francisco, CA

Image credit: Andrew Pogue

Project Status: Online

Project Size: 466,978 square feet

Alternate Water Source:
- Rainwater
- Graywater

End Uses:
- Toilet/Urinal Flushing
- Subsurface Irrigation

Treatment System Size: 8,000 Gallons/Day

Potable Water Use Reduction: 10%; 1,600,000 Gallons/Year

Drivers: San Francisco's Non-potable Water Ordinance, ownership sustainability goals

System Construction Cost: $900,000 (treatment + conveyance)

Annual O&M Cost: $50,000

Owner: Otis Property Owner, LLC

Project Description:

30 Otis is a 27-story mixed-use building designed by Multistudio Architects, consisting of 416 residential units, City Ballet School, Chorus Hall (Theater) public retail, and a 2-level underground parking garage. The building roof includes multiple outdoor terraces on different levels of the building. The project also features a public Plaza at the intersection of Otis Street, 12th Street, and South Van Ness Avenue which was designed by world renowned architect Frida Escobedo.

Rainwater collected from the building roof is directed to a collection tank, then treated using disc filtration, GAC adsorption, UV and chlorination disinfection. Greywater collected from showers, bathtubs and clothes washers in residential units is collected in a separate tank and treated using disc filtration, biological digestion, membrane filtration, UV and chlorination disinfection. Treated water is delivered to a treated water storage tank where distribution pumps supply the toilets, urinals and irrigation needs. Potable water make up is supplied to this tank to ensure continuous service to the building.

Drivers for Onsite Water Reuse:

Ownership and Operation: The onsite reuse system is an Aquacell system installed by Phoenix. It is owned by Otis Property Owner, LLC, who contracts the service and maintenance of the system to Epic Cleantec.

Ownership and Operation Model:

The onsite reuse system is an Aquacell system installed by Phoenix. It is owned by Otis Property Owner, LLC, who contracts the service and maintenance of the system to Epic Cleantec..

Project Cost and Funding:

The total cost of the development was around $134 million, and the construction cost of the Aquacell water reuse system was approximately $900,000, including the treatment system and conveyance system.

Reference:

Julian Marsh, Align Real Estate,
(jmarsh@alignrealestate.com)

Image credits:: EpicCleanTec

UN Plaza Foundation Drainage Project — Market Street

UN Plaza (image courtesy of Taylor Nokhoudian)

Project Status:
Construction Completed In 2020

SFDPH Permit Issued: No

Size: N/A

Alternate Water Sources:
- Foundation Drainage

End Uses:
- Irrigation
- Street Sweeping
- Make-Up Water in UN Plaza Fountain

Volume: 14,500 GPD;
5,292,500 Gallons/Year

Potable Water Use Reduction: TBD

Driver(S): Reduce Potable Water Use and Comply with Executive Directive 14-01

System Cost: $3,000,000

Annual O&M Cost: TBD

Owner: San Francisco Public Works

Project Description:

The UN Plaza is located along Market Street between 7th and 8th Streets in San Francisco's Civic Center neighborhood. The Plaza, which is publicly owned and maintained by San Francisco Public Works, was built in 1975 as part of the Market Street Reconstruction Project which coincided with the construction of the Bay Area Rapid Transit (BART) stations along Market Street. The majority of the Civic Center neighborhood was built over an underground branch of Hayes Creek. As a result, San Francisco Public Works encountered foundation drainage issues caused by the construction of a deep vault below the UN Plaza Fountain. Public Works recognized foundation drainage as a valuable alternate water source and historically pumped the water at UN Plaza to a truckfill station used for street cleaning on Market Street. However, that operation was abandoned over thirty years ago. Now, Public Works plans to restart water reuse operations underneath the UN Plaza Fountain and take back the under-utilized resource.

Per San Francisco Mayor Ed Lee's Executive Directive 14-01, San Francisco City and County Agencies are working to develop alternative local water sources. Following the intent of the Directive, Public Works and SFPUC began discussing the

possibility of implementing an innovative Foundation Drainage Reuse Project at UN Plaza. The project will recycle foundation drainage underneath the UN Plaza fountain for beneficial purposes such as irrigation, street sweeping, and use in the Plaza Fountain.

To treat the foundation drainage for reuse, the project will use multiple step media filtration coupled with disinfection. The treated water will be stored in a 15,000 gallon tank that will be located in the existing UN Plaza Fountain reservoir. The onsite water system is projected to provide 14,500 gallons of recycled water per day and 5,292,500 gallons annually.

Drivers for Non-potable Water Reuse:

A primary objective for Public Works is to reduce potable water use. Municipal street sweeping operations in the Civic Center and Tenderloin neighborhoods require multiple truck fills each day, using up to 6,000 gallons per day. Additionally, irrigation around the UN Plaza, City Hall, Civic Center Plaza, Asian Art Museum, and Main Library use up to 37,000 gallons per day, most of which could be met using this non-potable water supply. Lastly, the UN Plaza Fountain loses 50 gallons per week due to evaporation and the non-potable water supply will help offset this water demand. Implementing the onsite water system allows Public Works to utilize foundation drainage as a resource to offset their potable water needs in the UN Plaza area.

Ownership Model:

The proposed foundation drainage treatment and reuse system project is owned, operated, and maintained by San Francisco Public Works.

Project Cost:

The estimated cost for the onsite water system is $3,000,000.

Annual Operations & Maintenance Cost:

TBD

Service Costs to Residents or Tenants:

Not Applicable

Incentives provided by SFPUC:

The UN Plaza Foundation Drainage Reuse project received a $500,000 grant from the SFPUC through the Onsite Water Reuse Grant Program.

Reference:

Raymond Lui, San Francisco Public Works
(Raymond.Lui@sfdpw.org)

UN Plaza Fountain (image courtesy of Taylor Nokhoudian)

Moscone Center Expansion Project — 747 Howard Street

Moscone Convention Center (image courtesy of Skidmore, Ownings & Merrill LLP with Mark Cavagnero Associates, 2016. All rights reserved.)

Project Status: Online

SFDPH Permit Issued: Yes

Size: 1.5 Million Square Feet

Alternate Water Sources:
- Rainwater
- Foundation Drainage
- Steam Condensate

End Uses:
- Toilet/Urinal Flushing
- Irrigation around Moscone Center and The Yerba Buena Gardens
- Street Cleaning

Volume: 15 Million Gallons/Year

Potable Water Use Reduction: Meets 100% of Onsite Non-Potable Demands & Provides Offsite Potable Water Demand Offset

Drivers: LEED Certification, Compliance with San Francisco Mayoral Executive Directive 14-01, and Compliance with San Francisco's Stormwater Management Ordinance

Onsite Water System Cost: $2.5 Million

Annual O&M Cost Of Onsite Water System: TBD

Owner: Convention Facilities Department

Project Description:

City and County of San Francisco's Convention Facilities Department, in conjunction with San Francisco Public Works and the San Francisco Tourism Improvement District Management Corporation (SFTID), have partnered to develop the $500 million expansion to Moscone Convention Center. The project has a contiguous exhibition space of more than 500,000 square feet, three new ballrooms, more than 80 state-of-the-art new flexible meeting rooms, more than 20,000 square feet of secure outdoor spaces and more than 8,000 square feet of new public open space.

Aiming for LEED Platinum certification, the expanded convention center has several sustainable features, such as the largest rooftop solar array in San Francisco, zero-emissions electricity, and daylight harvesting to offset electrical lighting. The building is one of the most compact, efficient and sustainable convention centers in the U.S., with the lowest carbon footprint per visitor and one of the lowest energy consumption rates per visitor in the world. The building also has net-positive water usage, meaning that the project intends to export more non-potable water offsite than the amount of potable water consumed onsite.

As part of the expansion, the project showcases a district-scale onsite water system that harvests, treats, and reuses rainwater from the new building's roof, foundation drainage from the existing building, and steam condensate from the new building's

heating system. The rainwater, foundation drainage, and steam condensate are collected in a 70,000-gallon tank where it undergoes multi-step filtration and UV disinfection. After treatment, the water is distributed for use in Moscone Center's toilets and urinals, the irrigation systems around Moscone Center and Yerba Buena Gardens, and a street cleaning truck fill station that provides treated water for Public Works street cleaning trucks to use throughout the City. A district-scale onsite water system is optimal for Moscone Center and its neighbors due to the large demand for non-potable water in the area and the availability of a significant amount of foundation drainage. Overall, the onsite water system offsets more than 15 million gallons of potable water annually and helps the Moscone Center expansion export more water than the facility consumes.

Drivers for Non-potable Water Reuse:

The project team recognizes that reclaiming and reusing water is the right thing to do, particularly in a state with a history of drought. Other drivers include:

- The LEED Platinum certification target.
- San Francisco Mayor Ed Lee's Executive Directive 14-01, which requires San Francisco City and County agencies to develop alternative local water sources. Prior to the Directive, San Francisco Public Works implemented a strategy for an onsite water system to take advantage of local water resources for reuse.
- San Francisco's Stormwater Management Ordinance that requires projects disturbing 5,000 square feet or more of ground surface to decrease their post construction stormwater runoff rate and volume by 25% for the 2-year, 24-hour design storm.

Ownership Model:

The rainwater, foundation drainage, and steam condensate treatment and reuse system project is owned, operated, and maintained by San Francisco Conventions Facilities Department.

Onsite Water System Project Cost:

The estimated cost of the system is $2.5 million.

Annual Operations & Maintenance Cost of Onsite Water System: TBD

Service Costs to Residents or Tenants:

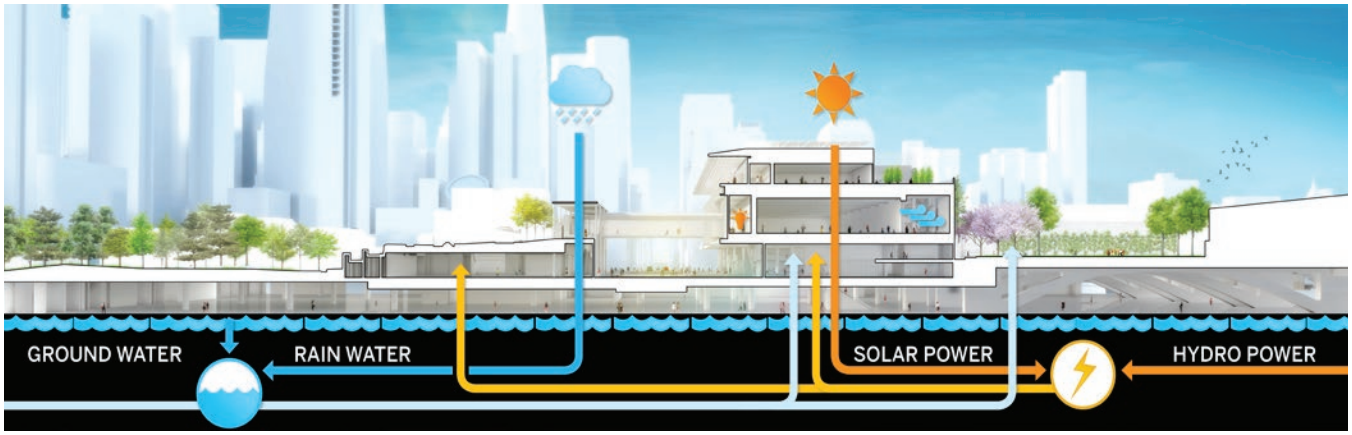
Not Applicable

Incentives provided by SFPUC:

The Moscone Center Expansion projectreceived a $500,000 grant from the SFPUC through the Onsite Water Reuse Grant Program.

Reference:

Steve Basic, The Moscone Center
(sbasic@moscone.com)



Moscone Convention Center is planning to implement an onsite water system (image courtesy of Skidmore, Ownings & Merrill LLP with Mark Cavagnero Associates, 2016. All rights reserved.)

Energy Center San Francisco-BART Foundation Drainage Project — Powell Street BART Station

Onsite reuse system at ECSF

Project Status: Online

SFDPH Permit Issued: Not Applicable

Size: Not Applicable

Alternate Water Sources:
- Foundation Drainage

End Uses:
- Steam Heating in Downtown San Francisco Steam Loop

Volume: 30 Million Gallons/Year

Potable Water Use Reduction: 30%

Drivers: Reduce Potable Water Use and Sustainability Goals

Onsite Water System Cost: $3.5 Million

Annual O&M Cost Of Onsite Water System: $200,000

Owner: Energy Center San Francisco

Project Description:

Beneath the crowds of people that visit Union Square every day, there is an under-utilized water source that flows directly under Powell Street BART station. Energy Center San Francisco (ECSF), owned by Clearway Energy, and BART have partnered on a unique project to bring that underground resource to the surface.

ECSF, formerly known as NRG, is the district steam heating system operator in San Francisco. 24/7/365 days a year, ECSF provides steam for heating, hot water and process steam to hotels and buildings in downtown San Francisco. Driven by their commitment to the sustainable use of energy and water, ECSF has partnered with BART on a project to reclaim foundation drainage at the Powell Street BART station, and redirect it to their District Energy Plant located nearby on Jessie Street for use in the district steam loop.

To maintain the structural integrity of its transportation system, BART captures foundation drainage from the Powell Street BART station in a large cistern and pumps it to SFPUC's sewer system. Recognizing an opportunity, ECSF approached BART to divert that water instead for use in the district steam loop.

ECSF first worked with BART to replace and upgrade the aging sump pumps at Powell BART station that were used to pump the foundation drainage to the sewer system. Next, a new pipeline roughly 1,000 feet long was constructed to transport the foundation drainage to the nearby plant located at 460 Jessie Street. From there, ECSF installed an onsite water treatment system to treat the foundation drainage to a quality that is suitable for use in a district steam heating system. The

onsite water treatment system includes a raw water collection tank with a coarse strainer, microfiltration (MF), and closed circuit reverse osmosis (CCRO). The water also undergoes softening to remove minerals that interfere with the process of steam production. This treatment system is unique in that the CCRO allows for 80-90% recovery of the treated water, as compared to 75% recovery from traditional RO systems.

Commissioning of the project began in September 2018. Currently, ECSF is operating the onsite water treatment system and will continue to monitor its integration with the district steam heating system. In total, ECSF is reducing their overall potable water use by 30 million gallons each year.

Drivers for Non-potable Water Reuse:

ECSF's innovative approach began with identifying foundation drainage as a resource rather than a nuisance to be discharged to the sewer. By tapping into this constant flow of groundwater, ECSF can reduce their overall water consumption by 30%. Their commitment to sustainability pushes them to continue investigating ways to use less potable water in their operations. Similarly, BART is dedicated to achieving its sustainability goals of reducing its impact on energy and water use. Through this joint effort, both BART and ECSF are demonstrating outstanding leadership and modeling the path for successful public-private partnerships in San Francisco.

Ownership Model:

The project is owned, operated, and maintained by ECSF. BART has agreed to grant ECSF access to use the foundation drainage.

Project Cost:

$3,500,000

Annual Operations & Maintenance Cost:

$200,000

Service Costs to Residents or Tenants:

Not Applicable

Incentives provided by SFPUC:

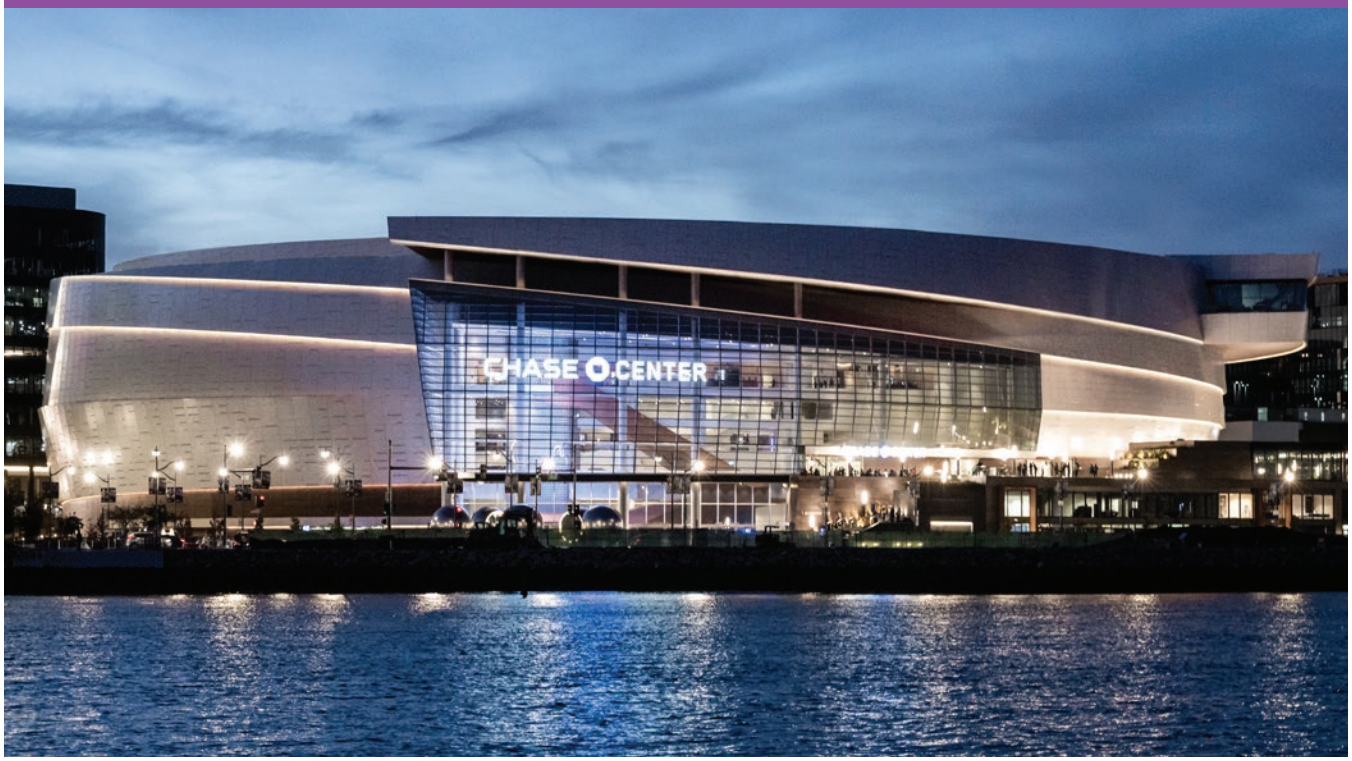
The SFPUC is providing a $500,000 grant to ECSF as part of the Onsite Water Reuse Grant Program. The project meets the grant criteria by offsetting at least 3 million gallons of potable water annually.

Reference:

Mike Eurkus, Energy Center San Francisco
(**Mike.Eurkus@cordiaenergy.com**)

The onsite reuse system captures, treats, and reuses foundation drainage for producing steam to heat downtown buildings in San Francisco.

Chase Center – San Francisco, CA



Chase Center arena (image courtesy of Chase Center)

Project Status: Completed

Project Size: 1,480,000 Square Feet

Alternate Water Sources:
- Rainwater
- Stormwater
- Graywater
- Condensate and Bleed

End Uses:
- Toilet/Urinal Flushing
- Spray Irrigation

Treatment System Size: 53,000 Gallons/Day

Potable Water Use Reduction:
34%; 3.8 Million Gallons/Year

Drivers: Stormwater Management Ordinance and Non-potable Water Ordinance Compliance

System Cost: $700,000

Annual O&M Cost: $50,000

Owner: GSW Arena LLC

Project Description:

The Chase Center arena is the Golden State Warrior's new state-of-the-art sports and entertainment complex in San Francisco's Mission Bay neighborhood. The development includes 580,000 square feet of office space in two towers adjacent to the arena, 100,000 square feet of retail space, and a 3.2-acre public plaza.

The non-potable water sources to be recycled include (1) rainwater collected from the two office towers' upper roof area and the arena roof, (2) stormwater collected from the plaza areas and the two office towers' podium roof area (3) graywater from the two office towers, and (4) condensate and bleed water from the two office towers' cooling systems. The on-site non-potable reuse applications include toilet/urinal flushing inside the arena and two office towers, as well as irrigation demand for the towers' landscaped roof spaces.

Due to the volume of water to be recycled and the disparity between high and low flow conditions, two identical Aquacell GX100 systems were installed for this project. Each GX100 grey & rainwater recycling system is capable of processing up to 26,400 gallons per day. Having two separate skids installed allows one to operate during low-flow conditions, and two to

operate during high-flow conditions. It also allows for uninterrupted operation during service & maintenance.

The system is completed and is awaiting occupancy in the office spaces (delayed due to pandemic), from which most of the graywater to be recycled will be generated. The system is anticipated to become active in late 2021.

Drivers for Onsite Water Reuse:

The rainwater reuse system is the outcome of achieving compliance with the Stormwater Management Ordinance and the City's Phase II MS4 permit. To comply with the Stormwater Management Ordinance, the arena complex was required to treat all stormwater on-site prior to discharge to the SFPUC separate storm sewer system and the Bay. The capture of graywater from the adjacent office towers and HVAC condensate was implemented to comply with the Non-Potable Ordinance.

Ownership Model:

GSW Arena LLC is the owner of the water reuse system. They have contracted with PHOENIX Process Equipment (Joint Venture Partner of Aquacell) for ongoing service & maintenance. PHOENIX Process Equipment monitors the systems operation remotely 24/7 and personnel are sent to the site regularly to calibrate instruments, perform maintenance, and collect water samples for analysis.

Project Cost and Funding:

The Chase Arena cost $1.5 Billion to construct, with the water reuse system components making up approximately $700,000.

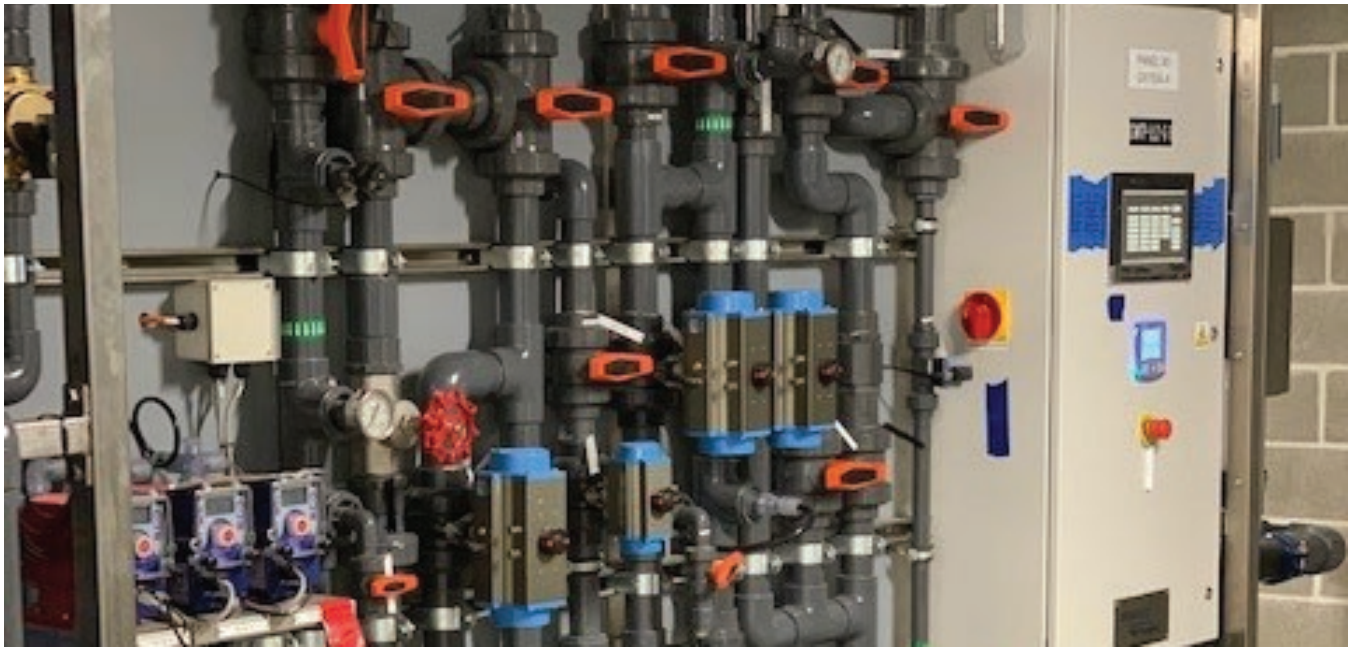
Lessons Learned:

Having a water reuse system representative present with contractors during the installation process is invaluable. The installation of the equipment, piping, and electrical conduit & wiring can be seamless if the installers have all the information they need. While this information is in the submittal package, much time, effort, and potential for confusion can be spared by talking through the installation steps with the individuals performing the work.

Taking steps to ensure that the installers can do their best work results in an optimal finished product. These systems tend to get a lot of attention since they are still a new concept to many contractors and building owners in the Bay Area. Tours of some Aquacell systems are given quite often; the installers know that their work will be on display and take pride in their work.

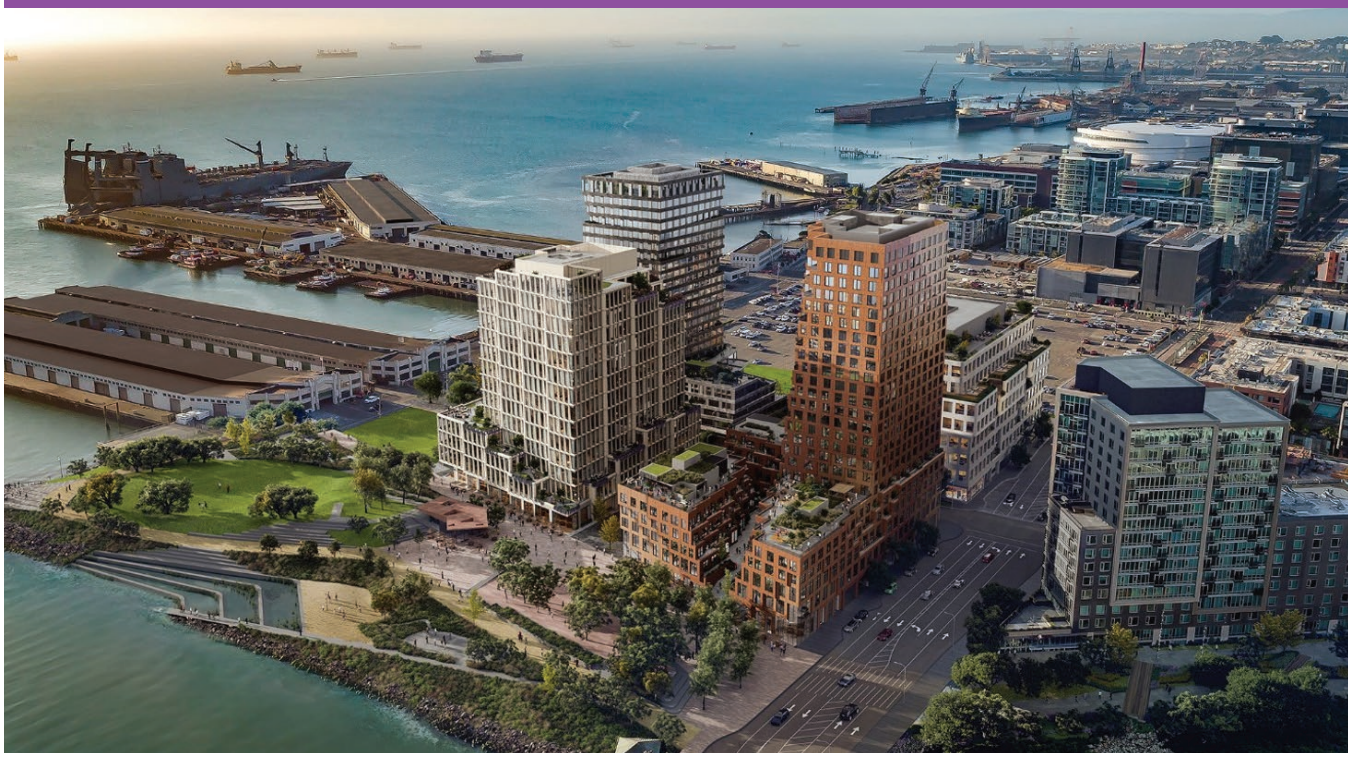
Reference:

Neil Joson, SJ Engineers
(njoson@sjengineer.com), 510-832-1505



Chase Center onsite reuse system (image courtesy of Aquacell)

Mission Rock at Third and Mission Rock Street – San Francisco, CA



Rendering of Mission Rock (image courtesy of Mission Rock Partners)

Project Status: Design

Project Size: 2.7 Million Square Feet

Alternate Water Sources:
- Blackwater

End Uses:
- Cooling Tower Make-Up
- Toilet/Urinal Flushing
- Irrigation

Treatment System Size:
Blackwater Treated: 64,000 Gallons/Day
Non-potable Water Produced: 43,000 Gallons/Day

Potable Water Use Reduction:
17%; 11.8 Million Gallons/Year

Drivers:
- The Eco-District Program
- Model Sustainable Development
- Non-potable Water Ordinance Compliance

System Cost: $8.4 Million (Estimated)

Annual O&M Cost: Not Available

Owner: Mission Rock Utilities, Inc.

Project Description:

Mission Rock will be a new mixed-used neighborhood spread over 28 acres, including parks, open space, residential, commercial, and retail. The Blackwater Treatment Plant, located on the ground floor of the Parcel B office building, is an advanced water recycling facility treating a portion of the blackwater from the Mission Rock development to meet the non-potable water needs of Mission Rock buildings, as well as the project open space. The blackwater consists of wastewater collected from the development's toilets, showers, and sinks. The primary non-potable water needs of the site will be irrigation and toilet flushing, along with cooling tower makeup water. Total blackwater inflow at the facility will be approximately 64,000 gallons per day, with a maximum design capacity of approximately 43,000 gallons of recycled non-potable water per day.

Drivers for Onsite Water Reuse:

The Blackwater Treatment Plant is being implemented to comply with San Francisco's Non-potable Water Ordinance. Additionally, the Mission Rock project is participating in the San Francisco Eco-District program. Eco-Districts are neighborhood scale public-private partnerships that strengthen the economy and reduce environmental impacts while creating a stronger sense of place and community. The Mission Rock development is looking to maximize this potential to deliver a sustainable, low-carbon neighborhood. To strengthen the project's commitment to sustainability, the Port and SWL 337 included a Sustainability Strategy as a component of their Disposition and Development Agreement. Mission Rock's Sustainability Strategy provides a comprehensive approach to achieve Mission Rock's goal of becoming a model for sustainable development in the city. Multiple sustainable site strategies have been evaluated to inform the targets and strategies included in the Sustainability Strategy. Important performance goals related to the District utilities include meeting 100% of building energy demands with renewable energy, reducing green-house gas emissions by 50% from the average development in San Francisco, and meeting 100% of non-potable water demands with non-potable sources.

Ownership Model:

Mission Rock Utilities, Inc. (MRU) will be structured as a mission-based utility business formed for the exclusive purpose of serving the Mission Rock site. The non-stock corporation will enter into long-term utility service agreements to secure revenue bond or construction financing. Energy and water rates will be cost-based and will include provisions for recovery of all capital and operational costs. MRU will have a board of directors appointed by the Developer and Owner's Master Association that will approve annual budgets and each system's rates.

MRU will consist of a Board of Directors with third-party operations and management teams. The daily business activities of MRU will be managed by Ever-Green Energy, through a Management Services Agreement. Daily operation and maintenance of the district energy and blackwater recycling systems are anticipated to be provided by two separate entities under contract with MRU. Tishman Speyer Properties personnel, likely engineering staff serving the broader Mission Rock project, will operate and manage both utility systems. A Contract Blackwater Recycling System Operations Firm will provide process operations and membrane maintenance functions for the blackwater recycling system and will serve as the Treatment System Manager.

Project Cost and Funding:

The Blackwater Treatment Plant is planned to be financed through 100% debt-financing, based on long-term utility service agreements that will require each property at Mission Rock to be a customer of the utility systems. The blackwater recycling system will be financed in phases with the initial financing expected to be funded over several years through exempt facility, private activity tax-exempt revenue bonds and taxable revenue bonds. Future Mission Rock public financing sources may contribute to paying down the financing.

Lessons Learned:

The biggest lessons learned are the institutional challenges of implementing a district scale non-potable water system, which were found to be greater than the technical challenges. Implementing the first district-scale blackwater plant in San Francisco has presented a number of technical, administrative and policy obstacles. From an administrative perspective, one challenge the team is working through with SFPUC is how billing will occur. As all buildings on the project will be impacted by the recycled water and potable water use of the other Mission Rock buildings, MRU will act as the invoicing agent for all potable water and recycled water use. SFPUC will invoice MRU directly for water and sewer services, and MRU will charge individual buildings based on metered water usage. This will enable proper allocation of water and sewer charges to each building, as well as any excess water use fees, if applicable.

The project may set an exciting new precedent for the city to consider building more distributed district scale plants in other areas, particularly in and near Mission Bay and in the southeast waterfront area where they could be connected to the purple pipe system that already exists in the streets.

Reference:

Steven Minden, Tishman Speyer & Mission Rock Partners (sminden@tishmanspeyer.com), 213-458-1272

Uber Mission Bay at 1455 and 1515 Third Street – San Francisco, CA

Uber Headquarters (image courtesy of HTEC)

Project Status: Completed

Project Size:
1455 Third St: 182,530 Square Feet
1515 Third St: 223,680 Square Feet

Alternate Water Sources:
- Rainwater
- Graywater

End Uses:
- Toilet Flushing
- Irrigation

Treatment System Size:
1,200 Gallons/Day (Graywater)

Potable Water Use Reduction: 22%; Graywater - 219,000 Gallons/Year,
Rainwater - 474,500 Gallons/Year

Drivers: Non-Potable Water Ordinance (Article 12C Compliance)

System Cost: $500,000 (Estimated)

Annual O&M Cost:
$23,000 Est. – Operation/Maintenance
$35,000 Est. – Article 12C Testing
$23,000 Est. – Treatment System Manager

Owner: Uber Technologies

Project Description:

The new San Francisco headquarters for Uber Technologies is comprised of two buildings: an 11-story building at 1455 Third St, and a 6-story building at 1515 Third St. Rainwater and graywater are collected from both buildings and treated at a facility within 1515 Third St before distribution to end use. This is the first district scale system to be permitted under Article 12C.

Storage tanks at 1455 Third St collect the building's rainwater and graywater in separate tanks. The collected rainwater and graywater are transferred to the storage tanks at 1515 Third St, where they undergo separate treatment processes before being combined in a treated water storage tank. The treated water is then used to meet the irrigation and toilet flushing demands of both buildings.

Rainwater is treated using an 800-micro prefilter, 30-micron sediment filter, and an 186mJ/cm2 UV disinfection tower with a combined collection volume of 24,000 gallons for both buildings. Graywater is treated using an 800-micron prefilter, NSF-350 certified membrane bioreactor, and an 186mJ/cm2 UV disinfection tower with a combined average treatment capacity of 1,200 gallons per day. Keeping the sources of influent in separate treatment trains reduces the size and cost of the overall system while still meeting or exceeding Article 12C log reduction targets.

Treated water residual disinfection per the Article 12C requirement is accomplished by an on-site sodium hypochlorite generator. The generator uses table salt to create an environmentally benign concentration of sodium hypochlorite and peroxide. This allows the facility to reduce the environmental and health hazards associated with the transportation, storage, and handling of highly concentrated sodium hypochlorite. A side stream recirculation loop is continuously monitored to maintain the required level of residual disinfection.

Drivers for Onsite Water Reuse:

This project falls under SFPUC's Article 12C requirement for an onsite non-potable water system to treat and reuse available graywater and rainwater for toilet flushing and irrigation.

Ownership Model:

Uber Technologies owns the building and the water reuse system. System designer Heat Transfer Equipment Company (HTEC) is contracted for operations and maintenance, and third-party affiliates will provide lab analysis and the treatment system manager role.

Lessons Learned:

As with the launch of any new regulatory policy, uncertainty around implementation and compliance led to several project-specific challenges along the way. The manufacturer had to seek clarification from the SFPUC and its third-party consultants on multiple occasions regarding Article 12C and its supporting documents to fully understand how to comply with the regulation. This iterative process allowed both the manufacturer and the SFPUC to more fully understand how projects can move forward under this new regulatory framework. The manufacturer was able to submit an approved treatment train that became the basis of design for future Article 12C projects.

It was important for HTEC to be able to pivot with changing site conditions during the COVID shutdown, and to be able to support the installation contractors understand the system, a type of system they had no prior experience with. HTEC spent many more hours on site than originally anticipated to assist with installation hurdles. This helped HTEC develop more comprehensive installation guides for plumbing and electrical that have benefited more recent system installations since. It is not yet clear how to navigate a conditional startup of the system during the buildings' limited initial occupancy, requiring further coordination with the Department of Public Health.

Reference:

Bill McCabe, Heat Transfer Equipment Company (bill@htecompany.com)

Onsite reuse system at Uber HQ (image courtesy of HTEC)

Future Non-potable Projects in San Francisco

Future Projects:

SFPUC staff continues to receive applications from developments proposing to implement non-potable water systems. Staff also regularly meets with project teams interested in integrating systems into future developments. The following is a list of projects in San Francisco that are proposing to implement non-potable water systems in the future:

Project Name	Alternate Water Source(s)	End Use(s)
India Basin	Blackwater	Irrigation, Toilet Flushing, Cooling Tower Make-up
1629 Market	Rainwater, Graywater	Irrigation, Toilet Flushing
88 Bluxome	Rainwater, Graywater	Irrigation, Toilet Flushing
598 Brannan	Rainwater, Graywater	Irrigation, Toilet Flushing
75 Howard	Rainwater, Graywater	Irrigation, Toilet Flushing
120 Stockton	Rainwater	Irrigation, Toilet Flushing, Cooling Tower Make-up
5M	Rainwater, Graywater	Irrigation, Toilet Flushing
725 Harrison	Rainwater, Graywater	Irrigation, Toilet Flushing
450 O'Farrell	Rainwater, Blackwater	Irrigation, Toilet Flushing
30 Van Ness Avenue	Rainwater, Stormwater, Graywater	Irrigation, Toilet Flushing, Cooling Tower Make-up
UC Hastings School of Law Campus Housing	Rainwater, Stormwater	Irrigation, Toilet Flushing
681 Florida Street Housing	Rainwater	Irrigation
1111 Pennsylvania	Rainwater	Irrigation
2465 Van Ness	Rainwater	Irrigation
921 Howard Street	Rainwater	Irrigation
Lofton at Nopo	Rainwater	Irrigation
531 Bryant Street	Rainwater	Irrigation