8. Onsite Alternative Water Sources

After implementing water-efficiency measures through facility modifications or efficient technologies, facilities can further reduce potable water use by taking advantage of onsite alternative water sources. An onsite alternative water source is the water discharge from one application or process that is captured, treated, and utilized in another application.[1] These onsite alternative water sources can vary greatly in quality and must be carefully matched with an appropriate end use. The U.S. Environmental Protection Agency (EPA) has developed comprehensive guidelines for water reuse to assist all types of organizations in identifying potential sources and uses of reused water.[2,3]

Potential onsite alternative water sources include:[4]

- Rainwater/stormwater
- Foundation drain water
- Treated gray water
- Condensate from air conditioning equipment
- Filter and membrane (e.g., reverse osmosis system) reject water
- Cooling equipment blowdown

Rainwater collection system

Although discharge from single-pass cooling systems can be a suitable onsite alternative water source, facility managers should first consider eliminating single-pass cooling, as described in *Section 6.2: Single-Pass Cooling*. If elimination is not feasible, then consider reuse of the discharge water for another purpose.

Potential uses of onsite alternative water sources include:[5]

- Irrigation
- Cooling tower make-up water
- Toilet and urinal flushing
- Make-up water for decorative ponds, fountains, and waterfalls
- Processes or other uses not requiring potable water
- Fume hood scrubbers

General considerations for reuse of onsite sources of water include the quality constraints of the source and the potential types of treatment that may be needed to meet the quality needs of the proposed end use. Although every situation is different, Tables 8-1[6] and 8-2[7] provide guidance on typical considerations.

[1] U.S. Energy Department (DOE), Energy Efficiency & Renewable Energy (EERE), Federal Energy Management Program (FEMP). February 2011. *Methodology for Use of Reclaimed Water at Federal Locations*. www1.eere.energy.gov/femp/program/waterefficiency_bmp14.html#resourceswww1.eere.energy.gov/femp/pdfs/reclaimed_water_use.pdf.

[2] U.S. Environmental Protection Agency (EPA). October 2012. Guidelines for Water Reuse. water.epa.gov/infrastructure/sustain/availability_wp.cfm.

[3] EPA. September 2004. Guidelines for Water Reuse. water.epa.gov/infrastructure/sustain/availability_wp.cfm.

[4] East Bay Municipal Utility District (EBMUD). 2008. *WaterSmart Guidebook—A Water-Use Efficiency Plan Review Guide for New Businesses*. Pages ALT1-8. www.ebmud.com/for-customers/conservation-rebates-and-services/commercial/watersmart-guidebook.

[5] *Ibid*.

[6] Adapted from Hoffman, H.W. (Bill). P.E. Water Management, Inc. January 25-26, 2011. Presentation in Phoenix, Arizona, to the Arizona Municipal Water Users Association.

[7] *Ibid*.

Table 8-1. Water Quality Considerations for Onsite Alternative Water Sources*

Possible Sources	Level of Water Quality Concern					
	Sediment	Total Dissolved Solids (TDS)	Hardness	Organic Biological Oxygen Demand (BOD)	Pathogens (A)	Other Considerations
Rainwater	Low/ Medium	Low	Low	Low	Low	None
Stormwater	High	Depends	Low	Medium	Medium	Pesticides and fertilizers
Air Handling Condensate	Low	Low	Low	Low	Medium	May contain copper when coil cleaned
Cooling Tower Blowdown	Medium	High	High	Medium	Medium	Cooling tower treatment chemicals
Reverse Osmosis and Nanofiltration Reject Water	Low	High	High	Low	Low	High salt content
Gray Water	High	Medium	Medium	High	High	Detergents and bleach
Foundation Drain Water	Low	Depends	Depends	Medium	Medium	Similar to stormwater

Note: The use of single-pass cooling water is also a possible source of clean onsite water, but facility managers should first consider eliminating single-pass cooling because of its major water-wasting potential. For that reason, it is not included in the list.

*Key:
Low: Low level of concern
Medium: Medium level of concern; may need additional treatment depending on end use
High: High concentrations possible and additional treatment likely
Depends: Dependent upon local conditions
(A): Disinfection for pathogens is recommended for all water used indoors for toilet flushing or other uses

Table 8-2. Types of Available Treatment Based on Intended End Use Quality Needs*

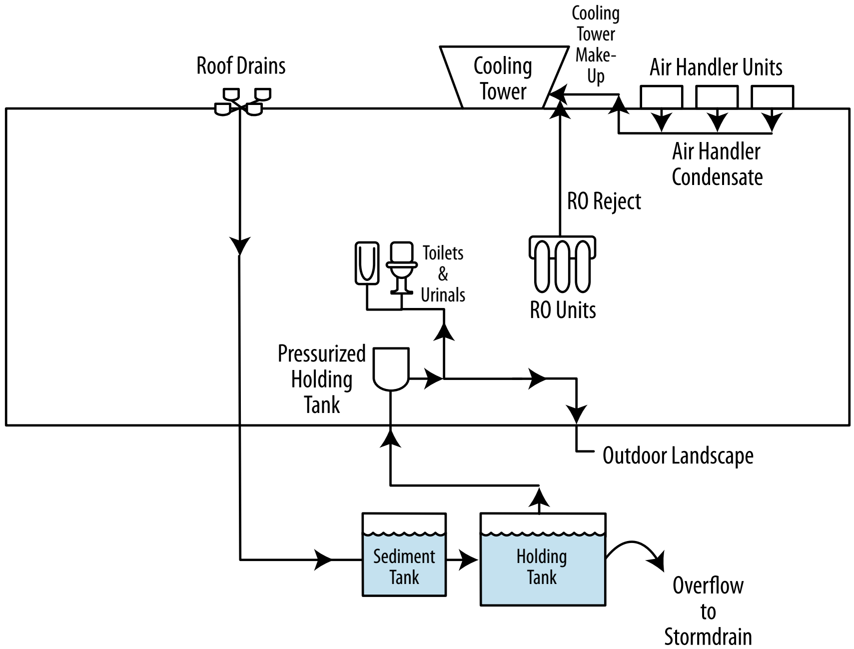
Possible Sources	Filtration	Sedimentation	Disinfection	Biological Treatment	Other Treatment Considerations
Rainwater	Depends	Depends	Depends	No	May be used for irrigation without additional treatment
Stormwater	Yes	Depends	Depends	Depends	For non-potable use only
Air Handling Condensate	No	No	Yes	No	Segregate coil cleaning water
Cooling Tower Blowdown	Depends	Depends	No	No	Consider TDS monitoring
Reverse Osmosis and Nanofiltration Reject Water	No	No	No	No	Consider TDS monitoring
Gray Water	No	Depends	No	Depends	Biologically unstable for long periods of storage unless treated; subsurface drip irrigation requires the least treatment
Foundation Drain Water	Depends	No	Depends	No	May be hard if in alkaline soils

*Key
Yes: Level of treatment likely needed
No: Level of treatment not likely needed
Depends: Treatment depends upon ultimate use

See Figure 8-1 for an example of a facility capturing and using various onsite alternative water sources.

Note: This section concentrates on onsite water sources that might be used or re-used. This is in no way intended to diminish the significant potential that the reuse of reclaimed water from municipal wastewater treatment facilities has to help reduce potable water use. Municipally supplied reclaimed water should always be considered for appropriate uses where available.

Figure 8-1. Examples of Onsite Alternative Water Use



Onsite Alternative Water Sources Case Study

To learn how the University of Texas at Austin used onsite alternative water sources to reduce its potable water use by more than 33 percent, read the case study in Appendix A.

Best Practices

Following are the first questions to evaluate when planning to use an onsite alternative water source:

- Are there end use(s) that can be substituted or supplemented with the onsite alternative water source?
- What are the volume requirements of the end use, particularly if the demand is seasonal in nature? Can the onsite alternative water source be matched to meet the demand of the end use in terms of quantity and availability?
- What are the water quality requirements of the end use? Can the onsite alternative water source meet those requirements?

- What treatment of the onsite source is necessary? Note that most alternative water sources will require treatment of some kind, ranging from simple filtration to full treatment in compliance with NSF International/American National Standards Institute (NSF/ANSI) 350, *Onsite Residential and Commercial Reuse Treatment Systems*.

- What are the basic design factors for capturing and delivering the onsite alternative water source to the end use? This includes the proximity of the source to the end use and piping, tanks, and construction that may be necessary to convey the water.

Because facilities' ability to capture and convey onsite alternative water sources varies, carefully evaluate the feasibility of using each source to determine the cost implications and payback periods.[8] Guidance on the construction, alteration, and repair of alternative water source systems for non-potable water applications is provided in the International Association of Plumbing and Mechanical Officials *Green Plumbing & Mechanical Code Supplement*.[9] Specific considerations for certain onsite alternative water sources are provided below.

Rainwater

Facilities with large areas of impervious cover can capture rainfall for use in non-potable applications. Rainwater that runs off of rooftops is typically of high quality, making it suitable for many end uses. In most facilities, it is used to supplement or replace irrigation water with little treatment or filtering.

To estimate the amount of rainwater that can be captured for each rain event, a good rule of thumb is to assume that 0.62 gallons of water can be collected per square foot of collection surface area per inch of rainfall. Most rainwater collection system installers will assume a capture efficiency of 80 percent, because some of the rainwater is lost through evaporation, splashing, or other means.[10] Equation 8-1 provides a calculation for rainfall capture potential.

Equation 8-1. Annual Rainfall Capture Potential (gallons per year)

= Roof Area x Annual Precipitation x Rainfall Capture per Roof Area (0.62) x Collection Efficiency (0.8)

Where:

- Roof Area (square feet)
- Annual Precipitation (inches per year)
- Rainfall Capture per Roof Area (0.62 gallons per square foot per inch of rain)
- Collection Efficiency (80 percent)

[8] EBMUD, op. cit.
[9] International Association of Plumbing and Mechanical Officials. February 2010. Green Plumbing & Mechanical Code Supplement. Pages 13-26. www.iapmo.org/pages/iapmo_green.aspx.
[10] EBMUD, *op. cit*.

Rainwater collection systems can be practical in all regions of the country, including those that experience frequent precipitation and more arid regions where water supplies are scarce. The major components of a rainwater collection system include:[11]

- Roofs or surfaces where rainwater can be collected
- Gutters and downspouts to transport the rainwater to storage
- Gutter screens to remove debris
- Storage tanks (cisterns)
- Conveyance systems to deliver stored water
- Water treatment, depending upon end use quality requirements

Rainwater that runs off of non-roof surfaces, such as parking lots, hardscapes, and landscapes, around a building can also be a good source of water for landscape irrigation, provided it can be captured, treated, and stored. Generally, this collected water can be captured and distributed from onsite features, such as berms, swales, or rain gardens, or can be diverted to a long-term storage detention pond, where the water can be pumped for landscape irrigation or other uses.[12] The quality of rainwater collected from the ground is much more variable than that collected from rooftops, because it can pick up pollutants as it travels across the landscape. It is important to carefully consider the water quality needs of the end use or provide appropriate treatment before rainwater is used.

Treated Gray Water

Gray water is wastewater from lavatory sinks, laundries, and bathing. It never contains wastewater from toilets or urinals and excludes wastewater from kitchen sinks.[13] Gray water can be treated and reused for specific onsite applications; however, health and safety concerns must be considered. Treated gray water should always be used within 24 hours of collection, or otherwise properly disposed, because it can foster bacteria and pathogens. If treated gray water is used for irrigation, it should only be applied below the surface and should never be used on plants intended for human consumption or sprayed through conventional sprinkler heads where it has the potential to be inhaled.[14]

The use of treated gray water as an onsite alternate water source requires a careful, site-specific analysis. Gray water is usually coarsely filtered to remove large, suspended solids and, when used for indoor purposes, is usually further sanitized with chemicals such as chlorine. The lowest level of treatment is typically sufficient for subsurface irrigation applications. More intensive treatment is necessary for other applications, including toilet and urinal flushing or above-ground irrigation. If considering installing a graywater treatment system, consult local health department officials first to ensure that the system meets appropriate regulations. Also, consult the manufacturers of the fixtures and equipment to which non-potable water is to be delivered to determine under what conditions those items can function with treated gray water and what impact such use will have on fixture and equipment warranties.

[11] DOE, EERE, FEMP. Best Management Practice: Alternate Water Sources. www1.eere.energy.gov/femp/program/waterefficiency_bmp14.html.
[12] EBMUD, *op. cit*.
[13] Alliance for Water Efficiency (AWE). Graywater Introduction.
[14] *Ibid*.

NSF/ANSI 350, *Onsite Residential and Commercial Reuse Treatment Systems*, establishes the minimum materials, design and construction, and performance requirements for onsite residential and commercial reuse treatment systems. It also encompasses residential wastewater treatment systems (i.e., those that treat all the wastewater flow from a residence, similar to the scope of NSF/ANSI Standards 40 and 245) and those that treat the gray water portion only. Further, gray water systems can be evaluated for treating bathing water only, laundry water only, or both. Reuse applications of the treated effluent include indoor restricted urban water use, such as toilet and urinal flushing, and outdoor unrestricted urban water use, such as surface irrigation.[15]

Condensate From Air Conditioning Equipment

Water vapor in the air condenses as it comes into contact with an air conditioner's cooling coils. This condensate must be removed to prevent water from damaging the equipment or building structure. Most often, the condensate is captured in a drip pan, where it is then discharged to the sewer system.

The amount of condensate generated depends upon the cooling load, relative humidity, and make-up air volumes.[16] Condensate generation ranges from three to 10 gallons per day per 1,000 square feet of air conditioned space, depending on the type of building and air conditioning system.[17] Condensate is generally high-quality and free of minerals and total dissolved solids (TDS). It is also generated in highest volumes during periods of high cooling loads, making it a good source for cooling tower make-up water. For more information on cooling towers, see *Section 6.3: Cooling Towers*.

Condensate is generally safe without additional treatment for direct use in cooling towers with biocide control, or for subsurface irrigation. However, condensate can grow bacteria removed from the air in the building. If the condensate is used for anything where humans can inhale it or come into direct contact with it (e.g., spray irrigation), it should first be filtered and disinfected.

Reverse Osmosis System Reject Water

Water treatment systems, such as reverse osmosis (RO) systems that use filters and membranes to remove impurities, will have a residual stream that remains after the purified water has been permeated through the membrane. Most RO systems have a recovery rate between 50 and 75 percent, meaning that 25 to 50 percent of the incoming water remains as residual and is rejected from the system.[18] This reject water is less pure than the source water entering the system but may still be useable for other purposes.[19]

[15] NSF International. NSF/ANSI Standards. July 2011. NSF/ANSI 350, Onsite Residential and Commercial Reuse Treatment Systems. www.nsf.org/business/wastewater_certification/standards.asp?program=WastewaterCer#std350.
[16] EBMUD, op cit.
[17] AWE. Condensate Water Introduction. www.allianceforwaterefficiency.org/Condensate_Water_Introduction.aspx.
[18] EPA and DOE, EERE, FEMP. May 2005. *Laboratories for the 21st Century: Best Practices, Water Efficiency Guide for Laboratories*. Page 5. www1.eere.energy.gov/femp/program/labs21_bmp.html.
[19] AWE. RO Discharge Water Introduction. www.allianceforwaterefficiency.org/RO_Discharge_Introduction.aspx?terms=alternate+water+source.

Reject water is typically sent directly to the sanitary sewer, although it is often suitable for use in other onsite applications. As long as sanitary conditions are maintained for storage and transfer, reject water can be appropriate for end uses requiring higher water quality, including: toilet and urinal flushing; cooling tower make-up water; above-ground irrigation; make-up water for decorative ponds, fountains, and waterfalls; or other processes or uses not requiring potable water.[20] If used for irrigation water, it should only be applied to plants with high salinity tolerances, due to elevated levels of TDS. In addition, if this water is to be used as cooling tower make-up water, compare the TDS concentration in the source to the cooling tower TDS set point, to make sure that it provides a benefit as make-up water to the system.

Cooling Equipment Blowdown

As water is evaporated from cooling equipment, the concentration of TDS builds up. If left undiluted, the TDS can cause scaling on equipment surfaces. As a result, some of the water remaining in the cooling equipment must be periodically blown down and replaced with make-up water. Cooling equipment that requires blowdown can include cooling towers, evaporative air condensers, evaporative coolers, and evaporative cooled air conditioners.[21]

Although cooling equipment blowdown is typically discharged to the sanitary sewer, it is often of sufficient quality to be used in other onsite applications such as irrigation. It should be noted that the TDS content is significantly higher than that of the original source water, often by two to five times. In addition, the water could contain algae, bacteria, or pathogens and water treatment chemicals, such as biocides or corrosion inhibitors. For these reasons, this water should never be used where it can come into contact with humans. In addition, if the cooling equipment is using water very efficiently, the TDS content could be too high for use in irrigation, unless it is diluted with water from another source.[22] Blowdown could be treated through nanofiltration or RO to make it suitable for other uses, particularly for recycling as make-up water for the cooling equipment. Facility managers should carefully assess the possible impacts of using this water on equipment, fixtures, or plants.

Additional Resources

Alliance for Water Efficiency (AWE). Blow-Down Water Introduction. www.allianceforwaterefficiency.org/blow_down_water_introduction.aspx.

AWE. Condensate Water Introduction. www.allianceforwaterefficiency.org/Condensate_Water_Introduction.aspx.

AWE. Graywater Introduction. www.allianceforwaterefficiency.org/graywater-introduction.aspx.

AWE. RO Discharge Water Introduction. www.allianceforwaterefficiency.org/RO_Discharge_Introduction.aspx?terms=alternate+water+source.

[20] *Ibid*.
[21] AWE. Blow-Down Water Introduction. www.allianceforwaterefficiency.org/blow_down_water_introduction.aspx.
[22] *Ibid*.

DOE, Energy Efficiency & Renewable Energy, Federal Energy Management Program (FEMP). Best Management Practice: Alternate Water Sources. www1.eere.energy.gov/femp/program/waterefficiency_bmp14.html.

DOE, Energy Efficiency & Renewable Energy, FEMP. February 2011. *Methodology for Use of Reclaimed Water at Federal Locations*. www1.eere.energy.gov/femp/program/waterefficiency_bmp14.html#resources.

East Bay Municipal Utility District. 2008. *WaterSmart Guidebook—A Water-Use Efficiency Plan Review Guide for New Businesses*. Pages ALT1-8. www.ebmud.com/for-customers/conservation-rebates-and-services/commercial/watersmart-guidebook.

EPA. October 2012. *Guidelines for Water Reuse*. water.epa.gov/infrastructure/sustain/availability_wp.cfm.

EPA. September 2004. *Guidelines for Water Reuse*. water.epa.gov/infrastructure/sustain/availability_wp.cfm.

International Association of Plumbing and Mechanical Officials. February 2010. *Green Plumbing & Mechanical Code Supplement*. Pages 13-26. www.iapmo.org/pages/iapmo_green.aspx.

NSF International. NSF/ANSI Standards. July 2011. *NSF/ANSI 350, Onsite Residential and Commercial Reuse Treatment Systems*. www.nsf.org/business/wastewater_certification/standards.asp?program=WastewaterCer#std350.