National Blue Ribbon Commission
for Onsite Non-potable Water Systems

A Guidebook for Developing and Implementing Regulations for Onsite Non-potable Water Systems

Technical Appendix

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Appendix A:
Acronyms and Terminology

Acronyms

AWRCE	Australian Water Recycling Centre of Excellence
BOD	Biological Oxygen Demand
C	Residual Disinfectant Concentration
DDW	State Water Resources Control Board's Division of Drinking Water
DVGW	Deutsche Vereinigung des Gas und Wasserfaches
EPA	Environmental Protection Agency
LRT	Log Reduction Target
LT2ESWTR	Long Term 2 Enhanced Surface Water Treatment Rule
MBR	Membrane Bioreactor
MF	Microfiltration
NSF	National Science Foundation
NTU	Nephelometric Turbidity Units
NWRI	National Water Research Institute
QMRA	Quantitative Microbial Risk Assessment
ONWS	Onsite Non-potable Water System
RME	Responsible Management Entity
RP	Reduced Pressure Principle Backflow Prevention Assembly
SWTR	Surface Water Treatment Rule
T	Contact Time
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UF	Ultrafiltration
UV	Ultraviolet light
UVT	Ultraviolet Light Transmittance
VOC	Volatile Organic Compound
WE&RF	Water Environment & Reuse Foundation
WRF	Water Research Foundation

Terminology

The following terms are used throughout the document and have the meaning set forth below.

Air Gap: A physical break between a supply pipe and a receiving vessel as set forth in the local or state plumbing code.

Alternate Water Source: A source of non-potable water that may include any of the following—graywater, roof runoff, stormwater, blackwater, and any other source approved by the state or local agency.

Blackwater: Wastewater originating from toilets, urinals, and/or kitchen counters (i.e., kitchen sinks and dishwashers).

Certified Laboratory: An environmental testing laboratory certified by an accepted state accreditation program or the National Environmental Laboratory Accreditation Program. Laboratories must be certified to perform each test for which they are providing results.

Challenge Test: The evaluation of a unit treatment process for pathogen $\log_{10}$ reduction performance using selected surrogate or indigenous constituents. In general, a surrogate is introduced to the process influent, and the process influent and effluent flow are monitored for the concentration of the surrogate.

Commercial Building: A building that is used for commercial purposes.

Continuous Verification Monitoring: Ongoing confirmation of system performance using sensors for continuous observation of selected parameters, including surrogate parameters that are correlated with pathogen log reduction target requirements.

Cross-connection: When a plumbing system allows water from one system (e.g., non-potable) to enter into another system (e.g., potable), resulting in the contamination of potable water.

Director: The Director of the state/local agency or any individual designated by the Director to act on his or her behalf, including, but not limited to inspectors, and has authority to enforce the program rules.

Disinfection: A physical or chemical process, including, but not limited to, ultraviolet radiation, ozonation, and chlorination that is used for removal, deactivation or killing of pathogenic microorganisms.

District-Scale Project: An ONWS for a defined service area that covers two or more properties and may cross public rights-of-way.

Domestic Wastewater: Wastewater collected from residential uses.

Enforceable Legal Agreement: A legally enforceable agreement defining the roles and responsibilities of each property owner or entity acting as a permittee, supplier, or user of an ONWS.

Field Verification: Performance confirmation study conducted using challenge testing, including surrogate microorganisms and/or other non-biological surrogates, usually during startup and commissioning and may be repeated as needed. The need for, duration, and extent of the field verification procedure will depend on characteristics of the ONWS.

First Flush Diverter: A device operated by mechanical float valves or other types of automatic control that diverts a quantity of roof runoff collected from a surface following the onset of a rain event.

Graywater: Wastewater collected from non-blackwater sources, such as bathroom sinks, showers, bathtubs, clothes washers, and laundry sinks.

Incidental Runoff: Unintended small amounts (volume) of runoff from ONWS irrigation use areas, such as unintended, minimal over-spray that escapes the ONWS irrigation use area. Water leaving an ONWS irrigation use area is not incidental if it is part of the facility design, if it is due to excessive application, if it is due to intentional overflow or application, or if it is due to negligence.

Indoor Use: Toilet and urinal flush water and clothes washing.

Local Agency: Any city, county, town, parish, or city and county with the jurisdictional authority to permit use of ONWS.

Log_{10} Reduction: The removal of a pathogen or surrogate in a unit process expressed in log_{10} units. A 1-log reduction equates to 90% removal, 2-log reduction to 99% removal, 3-log reduction to 99.9% removal, and so on.

Log_{10} Reduction Credit: The log_{10} reduction value credited to a treatment technology based on results of the technology's validation test results and proposed surrogate parameter for continuous monitoring.

Log_{10} Reduction Target: The log_{10} reduction target for the specified pathogen group (i.e., viruses, bacteria, or protozoa) to achieve the identified level of risk to individuals (10^{-4} infection per year).

Mixed-Use Building: A building that contains residential and commercial uses.

Monitoring Report: A report documenting the operation and water quality results of an ONWS permitted under the program rules.

Multi-Family Building: A residential building containing three or more dwelling units.

Multi-User Building: Any building that is not a single residence (e.g., multi-residential apartment, commercial, mixed use, and others).

Municipal Wastewater: Wastewater collected on a municipal scale that may include industrial wastewater.

Non-Potable Water: Non-potable water collected from alternate water sources, treated, and intended to be used on the project applicant's site or district-scale project and is suitable for direct beneficial use.

Non-Residential Building: A building that contains occupancies other than dwelling units.

Onsite Non-Potable Water System (ONWS): A system in which water from local sources is collected, treated, and used for non-potable uses at the building to district/neighborhood-scale, generally at a location near the point of generation.

ONWS Engineering Report (Engineering Report): Report submitted by project applicant to the local agency describing the ONWS in accordance with the program rules adopted by the local agency.

Operations and Maintenance Manual: Document providing comprehensive information on the ONWS operation, maintenance, and repair.

Permit: Permit to operate an ONWS issued and enforced by the local agency.

Permittee: The person(s) who holds a valid permit granted by the local agency to operate an ONWS. The Permittee is responsible for maintaining a permit, assuring that water collection, treatment, use, and water quality monitoring and reporting are consistent with the approved engineering report, the operations and maintenance manual, the program rules, and applicable state and local laws. A Permittee may also be the supplier and/or user.

Project Applicant: The person(s) or entity(s) applying for authorization to install and use an ONWS. The project applicant is responsible for applying for the permit, assuring that the ONWS is installed consistent with the approved engineering report, the operations and maintenance manual, the program rules, and applicable state and local laws.

Residential Building: A building that contains only dwelling units.

Roof Runoff: Precipitation from a rain or snowmelt event that is collected directly from a roof surface not subject to frequent public access.

Single-Owner Occupied: A stand-alone building within its own lot occupied by one group of residents.

Site Supervisor: In a district-scale project, the qualified person or entity designated by a user and/or supplier to oversee the operation and maintenance of the onsite distribution system and/or collection system and act as a liaison to the treatment system manager and/or permittee.

State Agency: The state agency with legal authority to administer and/or provide oversight to local agencies seeking to implement programs that allow for ONWS.

Stormwater: Precipitation runoff from rain or snowmelt events that flows over land and/or impervious surfaces (e.g., streets and parking lots). Stormwater also includes runoff from roofs with frequent public access.

Supplier: An entity that supplies an untreated alternate water source to the ONWS for treatment and reuse. A supplier may also be a permittee and/or user.

Surrogate Parameter: A measureable physical or chemical property that has been demonstrated to provide a direct correlation with the concentration of an indicator compound, can be used to monitor the efficiency of trace organic compounds removals by a treatment process, and/or provide indication of a treatment process failure.

Template for ONWS Engineering Reports: A fillable form identifying and describing the required elements of the ONWS engineering report.

Template for ONWS Annual Reports: A fillable form identifying and describing the required elements of the ONWS annual report.

Treatment System Manager: The qualified person or entity responsible for the daily management and oversight of the ONWS.

Unrestricted Irrigation: Irrigation of ornamental plants (i.e., non-food) and dust suppression.

User: An entity that accepts treated water from an ONWS for beneficial purposes within its area of occupancy. A user may also be a permittee and/or supplier.

Validation Report: Report documenting a detailed technology evaluation study that was conducted to challenge the treatment technology over a wide range of operational conditions. The validation report shall include evidence of the treatment technology's ability to reliably and consistently achieve the log reduction value, including information on the required operating conditions and surrogate parameters that require continuous monitoring.

Water Balance: The calculation of the potential volume of onsite alternate water supplies and demands of a development project.

Water Balance Documentation: An in-depth assessment of the Project Applicant's non-potable water use, including survey information, water meter readings, water service billing information, ONWS schematic drawings, or any other information deemed necessary by the local agency. For proposed district-scale projects, water balance documentation shall include implementation information that, at a minimum, shall address potential infrastructure and public right of way conflicts, demonstrate compliance with all applicable requirements, and establish the capabilities of the project applicant to effectively operate the district-scale system.

Appendix B:
Example Treatment Technologies, Treatment Trains, and Monitoring

This appendix includes example treatment technologies, treatment trains, and monitoring that could be used to achieve the necessary LRTs. In order to meet the LRTs for the range of alternate water sources and end uses, treatment processes are designed in series to create an effective treatment train. Treatment processes can achieve pathogen removal and/or inactivation credits to meet the LRTs based on accepted pathogen crediting frameworks. The following treatment trains provide examples of how to meet the LRTs with common treatment technologies including microfiltration (MF), ultrafiltration (UF), membrane biological reactor (MBR), ultraviolet light (UV) disinfection, and chlorination. Other treatment technologies such as ozone disinfection and wetland treatment systems are not featured in these examples.

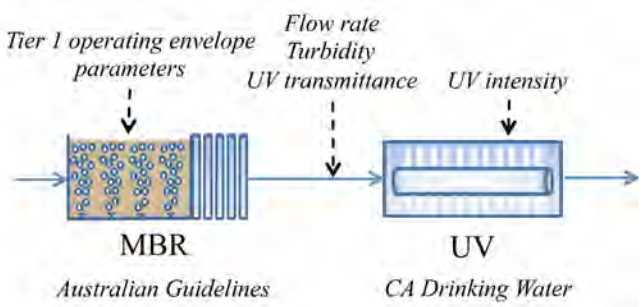
The template treatment trains are adapted from Technical Memorandum on Pathogen Crediting Frameworks for Decentralized Non-potable Water Systems, Trussell Technologies 2017. These treatment trains are not meant to be prescriptive, but to illustrate potential approaches for the design of ONWS treatment trains using existing pathogen crediting frameworks.

Graywater

An example treatment train for ONWS treating graywater for indoor use is presented in Figure B-1. The treatment train includes an MBR and UV, with the MBR meeting the Australian guidelines for receiving pathogen credits. In addition, the MBR effluent quality (i.e. turbidity and UVT) must fall within the validated range for the UV reactor. The UV system provides a dose greater than or equal to 150 mJ/cm^2 under all validated operating conditions, as demonstrated through online monitoring of several parameters. This treatment train exceeds the virus, protozoa, and bacteria LRTs.

Figure B-1

Example treatment train for ONWS treating graywater. Log reduction targets are based on a health risk assumption of 10^{-4} infections per person per year.



Pathogen Credits			Total	Required
V	1.5	6	**7.5**	**6**
G	2	6	**8**	**4.5**
C	2	6	**8**	**4.5**
B	4	6	**10**	**3.5**

Validation & Field Verification Requirements	
Field verification of operation within Tier 1 envelope	Validation for dose of 150 mJ/cm^2 per EPA, NSF, or DVGW

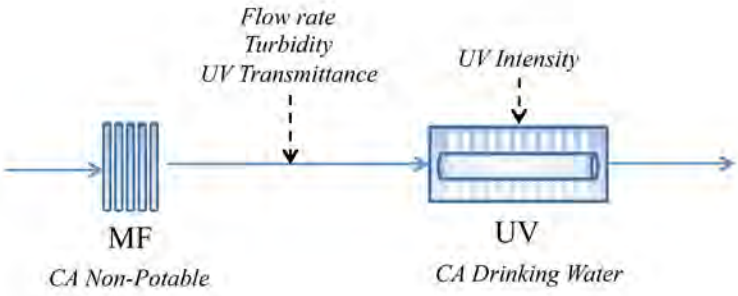
Treatment Requirements	
Effluent turbidity ≤ 0.2 NTU Operation within Tier 1 envelope	Influent UVT ≥ minimum validated value for UV reactor UV dose ≥150 mJ/cm^2

Stormwater

An example treatment train for ONWS treating stormwater (10^{-3} dilution) for indoor use is provided in Figure B-2, along with the validation, field verification, monitoring, and treatment requirements. The treatment train includes MF and UV, with MF being credited according to the California non-potable reuse regulations and UV according to the drinking water regulations. The use of MF instead of MBR in this train may be acceptable assuming that stormwater has significantly lower organic loads than graywater. This assumption would need to be confirmed in each case using site-specific water quality data.

Figure B-2

Example treatment train for ONWS treating stormwater (10^{-3} dilution of wastewater). Log reduction targets are based on a health risk assumption of 10^{-4} infections per person per year.



	Pathogen Credits		Total	Required
V	0	3.5	**3.5**	**3.5**
G	0	6	**6**	**3.5**
C	0	6	**6**	**3.5**
B	0	3.5	**3.5**	**3**

Validation & Field Verification Requirements

None	Validation for dose of 80 mJ/cm² per EPA, NSF, or DVGW

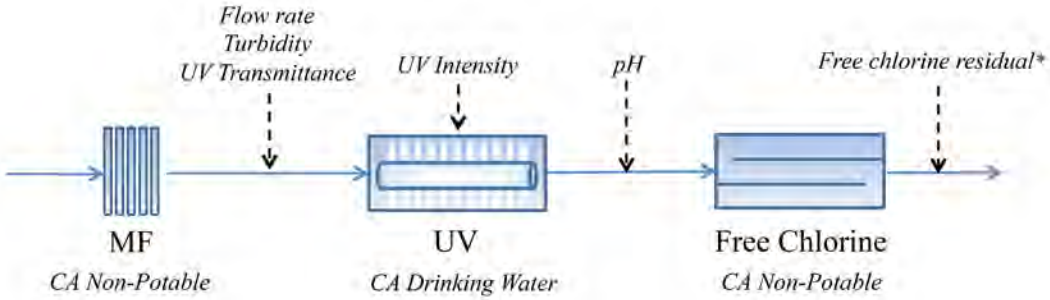
Treatment Requirements

Effluent turbidity: - 95% ≤ 0.2 NTU - Never > 0.5 NTU	Influent UVT ≥ minimum validated value for UV reactor UV dose ≥ 80 mJ/cm²

An example train for ONWS treating stormwater (10^{-1} dilution) for indoor use is provided in Figure B-3; the train consists of MF, UV, and free chlorine. The MF is not credited with pathogen removal and/or inactivation, in accordance with California non-potable reuse requirements. In addition to meeting the non-potable effluent turbidity standards, the MF effluent must fall within the validated water quality range of the UV reactor. The UV reactor must provide a dose of at least 80 mJ/cm^2. The chlorine system must provide a CT of no less than 10 mg-min/L, with a verified **free** chlorine residual. A free chlorine dosing control system is required to ensure that free chlorine residual is maintained even in the presence of ammonia in the feedwater. This treatment train exceeds the virus, protozoa, and bacteria LRTs. As with the 10^{-3} stormwater treatment train, the water quality of the source water should be evaluated to verify that sufficient organics control can be obtained without the use of MBR, i.e., with MF alone.

Figure B-3

Example treatment train for ONWS treating stormwater (10^{-1} dilution of wastewater). Log reduction targets are based on a health risk assumption of 10^{-4} infections per person per year.



	Pathogen Credits			Total	Required
V	0	3.5	5	**8.5**	**5.5**
G	0	6	0	**6**	**5.5**
C	0	6	0	**6**	**5.5**
B	0	3.5	5	**8.5**	**5**

Validation & Field Verification Requirements		
None	Validation for dose of 80 mJ/cm^2 per EPA, NSF, or DVGW	Tracer study or assumed baffling factor of 0.1

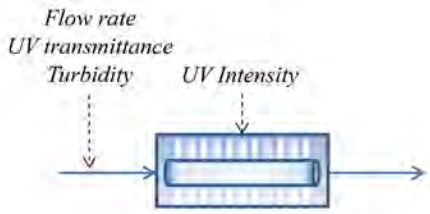
Treatment Requirements		
Effluent turbidity: - 95% ≤ 0.2 NTU - Never > 0.5 NTU	Influent UVT ≥ minimum validated value for UV reactor UV dose ≥ 80 mJ/cm^2	CT no less than 10 mg-min/L** with verified free chlorine residual

Roof Runoff

The Sharvelle et al., 2017 report specifies only bacterial LRTs for roof runoff; there are no LRTs for virus or protozoa. The example treatment train in Figure B-4, showing ONWS treating roof runoff for indoor use, uses UV with a dose of 80 mJ/cm^2 to achieve the bacterial LRTs. This treatment train may need to be preceded by a filtration step to remove solids; this determination should be made based on the quality of a particular source water.

Figure B-4

Example treatment train for ONWS treating roof runoff. Log reduction targets are based on a health risk assumption of 10^{-4} infections per person per year.



		Total	Required
V	N/A	N/A	N/A
G	N/A	N/A	N/A
C	N/A	N/A	N/A
B	3.5	3.5	3.5

Validation & Field Verification Requirements

Validation for dose of 80 mJ/cm^2 per EPA, NSF, or DVGW

Treatment Requirements

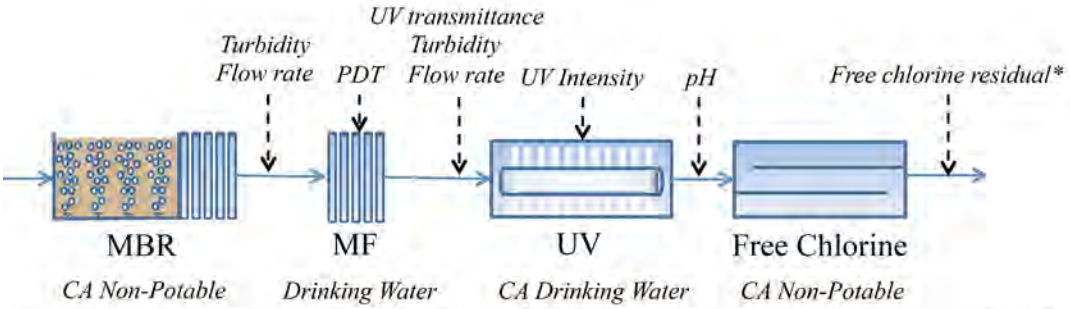
Influent turbidity:
- 95% ≤ 0.3 NTU; never > 1 NTU
Influent UVT ≥ minimum validated value for UV reactor
UV dose ≥ 80 mJ/cm^2

Blackwater

Two example treatment trains for ONWS treating blackwater for indoor use are shown in Figure B-5 and B-6. The key difference between these trains is whether or not the MBR receives pathogen credit. Figure A-5 includes an MBR, MF, UV, and free chlorine. In this train, the only requirement for the MBR is that it meets the California non-potable effluent turbidity standards. The MF can receive protozoa credit with a daily pressure decay test and effluent turbidity meeting the drinking water standards. In addition, the MF effluent quality must be within the validated range of the UV reactor. The MBR is not replaced by the MF because the biological treatment is necessary to reduce the concentration of organics. The MF is included to obtain the additional necessary protozoa credit. The chlorine system must provide a CT of no less than 10 mg-min/L, with a verified free chlorine residual. A free chlorine dosing control system is required to ensure that free chlorine residual is maintained even in the presence of ammonia in the feedwater.

Figure B-5

Example treatment train A for ONWS treating blackwater. Log reduction targets are based on a health risk assumption of 10^{-4} infections per person per year.



	Pathogen Credits				Total	Required
V	0	0	3.5	5	**8.5**	**8.5**
G	0	4	6	0	**10**	**7**
C	0	4	6	0	**10**	**7**
B	0	0	3.5	5	**8.5**	**6**

Validation & Field Verification Requirements			
None	None	Validation for dose of 80 mJ/cm² per EPA, NSF, or DVGW	Tracer study or assumed baffling factor of 0.1

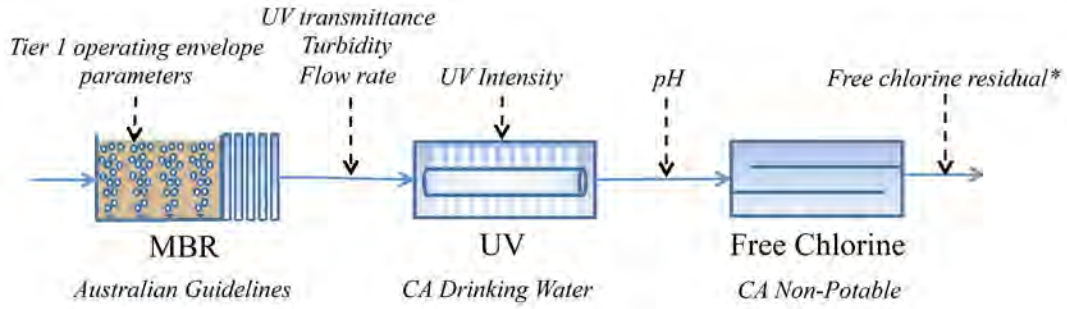
Treatment Requirements			
Effluent turbidity: - 95% ≤ 0.2 NTU - Never > 0.5 NTU	PDT ≤ control limit Effluent turbidity ≤ 0.15 NTU	Influent UVT ≥ min validated value for UV reactor UV dose ≥ 80 mJ/cm²	CT no less than 10 mg-min/L** with verified free chlorine residual

** System must have chlorine dosing control system to ensure free chlorine residual in the presence of ammonia in feedwater*
*** See Maguin et al. (2009), Huitric et al. (2014), Pecson (2016)*

Figure B-6 consists of an MBR, UV, and free chlorine. In this train, the MBR receives pathogen credit per the Australian guidelines. The MBR must operate within the Tier 1 operating envelope, with an effluent turbidity ≤ 0.2 NTU. The MBR effluent must be within the validated range of water quality of the UV reactor. The UV reactor (or multiple reactors in series) must provide a UV dose of 80 mJ/cm^2 to receive 3.5-log virus and bacteria credit and 6-log protozoa credit. The remaining virus credits are obtained through free chlorine disinfection per the same requirements noted in example treatment train A for ONWS treating blackwater.

Figure B-6

Example treatment train B for ONWS treating blackwater. Log reduction targets are based on a health risk assumption of 10^{-4} infections per person per year.



	Pathogen Credits			Total	Required
V	1.5	3.5	5	**10**	**8.5**
G	2	6	0	**8**	**7**
C	2	6	0	**8**	**7**
B	4	3.5	5	**12.5**	**6**

Validation & Field Verification Requirements

Field verification of operation within Tier 1 envelope	Validation for dose of 80 mJ/cm^2 per EPA, NSF, or DVGW	Tracer study or assumed baffling factor of 0.1

Treatment Requirements

Effluent turbidity ≤ 0.2 NTU Operation within Tier 1 envelope	Influent UVT ≥ minimum validated value for UV reactor UV dose ≥ 80 mJ/cm^2	CT no less than 10 mg-min/L** with verified free chlorine residual

** System must have chlorine dosing control system to ensure free chlorine residual in the presence of ammonia in feedwater*
*** See Maguin et al. (2009), Huitric et al. (2014), Pecson (2016)*

Appendix C:
Sample Engineering Report

This template is intended to aid Permit Applicants in writing an ONWS Engineering Report. ONWS vary in complexity; therefore, reports will vary in content, and the detail presented will depend on the scope of the proposed project. The report should contain sufficient information to assure the local agency that the degree and reliability of treatment is commensurate with the requirements for the proposed use and that the distribution and use of the treated non-potable water will be protective of public health.

The local agency should approve the engineering report as the permitting agency for the operation of ONWS in Residential Buildings containing three or more dwelling units, in non-Residential Buildings, and where ONWS are shared across property lines or in multiple structures.

Onsite Non-potable Water System Engineering Report

[Insert Responsible Party]
[Insert Project Name]
[Insert Project Address]

Prepared by:
[Insert Engineer Name]
[Insert Company Name]
[Insert Company Address]
[Insert Registered Professional Engineer Seal and Signature]

Submitted to: Local agency
Date: [Insert Date]

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List of Tables

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Appendices

Component Cut Sheets must be included

1. General

This Section is used to provide background on the project.

The following text should be included:
"This Engineering Report was prepared by [Engineering Firm] as consultants to [Project Applicant/Permittee], who is the Project Applicant for the [Project Name]. The objective of this Engineering Report is to demonstrate how the Project complies with the Program Rules and requires that an Engineering Report be prepared and submitted to the Director for review and approval prior to providing treated alternate water sources to non-potable end uses."

1a. Project Overview

Provide a brief overview of the project including:

- Project objectives
- Project location and ONWS location within parcel
- Project description – development type (commercial, residential, mixed)
  - Size square footage breakdown by usage
  - Number of residents and number of residential units (if applicable)
  - Number of non-resident employees (if applicable)
- Alternate Water Source(s) treated (type and anticipated max/min/avg daily flowrate)
- Non-potable water uses (type and anticipated max/min/avg daily flowrate)
- ONWS description

Sample Figure 1: [Insert a vicinity map of all parcels associated with the Project]
Sample Figure 2: [Insert a plan/layout for the ONWS]

2. Regulatory Requirements

This Section is used to confirm the Project Applicant/Permittee and its consultants understand the specific regulatory requirements for ONWS specific that apply to the project.

Identify all requirements for alternate water source management, non-potable water use, plumbing, easements, etc. that apply to the project.

3. Project Applicant/Permittee

This Section is used to demonstrate that the Project Applicant/Permittee has the technical and managerial capacity to build and operate the proposed project.

3a. Roles and Responsibilities

- Identify and describe the Project Applicant/Permittee as well as the Supplier, Producer, and User.
    - If more than one entity is involved, describe the roles and responsibilities of each with respect to treatment, distribution, and use of alternate water sources.
    - If contracts exist between parties involved in the ONWS, they may be provided as an appendix.
- Intended users of the treated non-potable water and/or Site Supervisor(s).
    - Describe how site supervisor(s) will be trained.

3b. Treatment System Manager Qualifications and Training

Identify the following:

- ONWS staffing requirements
- Brief description of education and experience
- Licenses or certifications and expiration dates
- System operations support plan, including plans for near and long-term contractual services

4. Alternate Water Source(s)

This Section is used to clarify and document the source of water, collection system, and any associated issues or challenges.

4a. Alternate Water Sources and Flows

Identify the following:

- Source water type(s) and brief description of collection system.
- Anticipated raw water quality of the alternate water source(s) that will govern the design of the proposed treatment process
- Anticipated range of volumes and flow rates of the alternate water source(s)

4b. Source Water Availability and Use

Provide a summary of the anticipated water availability and end uses. Identify the hydraulic loading rates to enable evaluation of system adequacy.

Sample Table 1: Anticipated Flows

Design Parameters	Value (Units)
<Average Daily Inflow>	
<Average Daily Distribution>	
<Number of Toilets Served>	
<Average Daily Number of Users>	
Etc.	

4c.Source Water Quality Summary

Provide a summary of anticipated water source quality and any necessary source control requirements. Identify the source water origin so that the contaminant loading is understood.

Sample Table 2: Alternate Water Source Characteristics

Water Quality Parameter	Value (Units)
<Flow Rate>	
<Total Coliform>	
<BOD>	
<TSS>	
Etc.	

5. ONWS – Treatment Process and Operations and Maintenance

This section is used to describe the ONWS and demonstrate that the treatment scheme will meet requirements for water quality and treatment specific to its project type. This section should be written in order following the treatment schematic and should include design criteria for each treatment process.

Provide a general description of the ONWS processes and provide a schematic of the proposed treatment train.

Sample Figure 3: [Schematic/Process Flow Diagram for ONWS]

Sample Table 3: System Component Capacity Summary

System Component	Function	Capacity/Design Value (Units)	Description/Notes
<Pump brand name>	<chemical feeder, booster,…>	<power rating, flow capacity, etc>	
<Storage>	<settling, equalization, storage,…>	<size and material>	<safety factor notes or other design considerations.
<filter type/brand name>	<filtration>	<capacity and material>	
<UV unit>	<disinfection>	<operating life, flow capacity, … >	
Etc.			

5a. <Insert Individual Treatment Process Name>

Insert sections as appropriate to provide the design basis for each treatment process, including selected equipment, loading rates, contact times, filtration type, chemicals used, etc.

Below, sample information is provided for different treatment processes, but is not prescriptive or exhaustive as specific requirements will be approved by the state or local agency based on details provided by the Project Applicant in this Engineering Report.

EXAMPLE: Membrane Filtration

All filtration design criteria should be provided including filtration and backwash rates, filter media specifications, the expected turbidities of the filter influent, and effluent. For microfiltration (MF) and ultrafiltration (UF) membranes seeking pathogen log reduction credits, information should include a description and calculation of how the

system defines an acceptable PDT value per the EPA's Membrane Filtration Guidance Manual.

EXAMPLE: Membrane Bioreactor (MBR)
All MBR design criteria should be provided including membrane filtration design criteria.
For MBRs seeking pathogen log reduction credits, provide evidence of ability to operate MBR within Tier 1 operating boundaries as outlined in Australian Water Recycling Center of Excellence's Membrane Bioreactor WaterVal Validation Protocol.

EXAMPLE: Reverse Osmosis (RO)
All RO design criteria should be provided in including RO media specifications, expected sodium chloride rejection, and the system recovery. Include a description of the surrogate parameters (typically electrical conductivity or total organic carbon) that will be used to calculate log reduction credits and justification for the LRV credits being requested. See the EPA's Membrane Filtration Guidance Manual for additional information.

EXAMPLE: Ultraviolet Light (UV) Disinfection
A minimum dose of 80 mJ/cm2 should be provided. Provide a schematic and detailed description of the UV disinfection system. Include the following minimum information:

- Description of UV reactor, number, manufacturer, and type of UV lamps, ballast, modules, banks and electrical facilities.
- Sleeve configuration and characteristics
- Monitoring and controls, including the number, location, and function of monitoring equipment
- Required operating conditions (influent turbidity, UV transmittance, UV intensity, etc)

UV reactor validation is required. UV Validation Reports shall be prepared by a licensed engineer. Validation reports must provide evidence of reactor's ability to reliably and consistently achieve the log reduction value, including information on the required operating conditions and surrogate parameters that require continuous monitoring. The Validation Report shall document results based on validation testing completed utilizing one of the following:

- EPA UV Disinfection Guidance Manual (USEPA 2006)
- German UV Devices for the Disinfection for Drinking Water Supply Standard (DVGW 2006)
- NSF/ANSI 55A Standard for UV Water Treatment Systems (NSF/ANSI 2016)

Submitted validation reports must include a letter demonstrating the report has been accepted previously by a state public health official.

EXAMPLE: Chlorine Disinfection

Provide evidence of chlorine dose, including the method for measuring chlorine residual and how contact time will be determined. The EPA has compiled CT tables for several disinfection and pathogen types.

CT = Disinfectant residual concentration (C) x Contact Time (T)

Contact time is typically demonstrated by conducting a tracer study or "rule of thumb" baffling factors. See the EPA's Disinfection Profiling and Benchmarking Guidance Manual

EXAMPLE: Ozone Disinfection

Provide evidence of ozone dose, including the method for measuring ozone residual and how contact time will be determined. The EPA has compiled CT tables for several disinfection and pathogen types.

CT = Disinfectant residual concentration (C) x Contact Time (T)

Contact time is demonstrated by conducting a tracer study. See the EPA's Disinfection Profiling and Benchmarking Guidance Manual

5b. Pathogenic Microorganism Control

Identify the log reduction targets that apply to the project and provide evidence that the proposed ONWS will achieve the treatment objectives. Evidence includes treatment certification, validation reports, performance studies, or accepted treatment LRV listings.

Sample Table 1: Anticipated Log Removal Credits

Pathogen	<Insert column for each treatment process seeking LRV credits>	Total	Required
Virus			
Pathogen			
Bacteria			

5c.Chemical Storage and Feed Equipment

Identify the following for each chemical:

- Name and CAS number
- Point of application
- Method and degree of mixing
- Dosages
- Chemical storage and handling facilities

5d. Source of Power

Identify the source of power required for treatment.

5e. Solids Handling (if applicable)

Identify the means of handling treatment residuals, if applicable.

5f. Operations and Maintenance planning and manual development

Identify the following:

- Process for development: (timeline, Project Applicant/Permittee):
- Anticipated process and timeline for updating after the system is permitted

6. Reliability Features

This Section should describe the ONWS reliability features including how the location will be staffed, how alarms will be received, and who will be notified. The plan for ensuring total system reliability should address treatment effectiveness, process and water quality monitoring, operations and control, contingency control and response, and the safe delivery and use of water.

6a. System reliability

This Section should describe how the equipment used to monitor treatment, operations, and water quality enables the determination of whether the system is working as planned.

Provide a general assessment of system reliability. Identify the following:

- Description of reliability controls
- Description of automated and/or manual treatment and distribution controls systems
- Hydraulic control and overflow prevention
- Alternate Water Source supply reliability

6b. Occupancy and staffing

Identify the following:

- Hours building will be occupied
- Hours Treatment System Manager will be present onsite

6c.Monitoring, Control, and Alarms

This Section should describe how the monitoring and controls of the systems will enable the operators or automatic controls to intervene in the event of a power failure, process upset, or the production of off-specification water.

Identify the following:

- Description of notification of alarm condition or system malfunction
    - Loss of power from normal power supply
    - Process failures
- Notifications
    - Where the alarm or notification will be received
    - How the alarm receipt location is staffed
    - Who will be notified upon receipt of an alarm
- Power supply for alarm devices

7. Supplemental Water Supply and Cross- Connection Control

This Section should describe supplemental water supply, frequency of use, and method of cross connection control.

7a. Make-up Water Supply Description

Identify the following:

- Make-up water source, quality, quantity, and mode of delivery
- Short description of anticipated circumstances when make-up water would be utilized

7b. Cross Connection and Backflow Prevention Measures

This section should identify the cross connection and backflow prevention measures that will be installed and maintained to comply with the Program Rules.

Provide the following:

- Responsible party for cross-connection control and control of access to plumbing
- Alternate water source plumbing design and proximity to potable water plumbing.
- Backflow prevention device(s) and assemblies

7c.Provisions for Outages

This Section should describe contingencies to handle a loss of service due to planned or unplanned shutdowns of the project.

Identify the following:

- Provide any relevant information or special considerations for the use of supplemental above and beyond the volumes described above for make-up water supply
- If supplemental water is not available during outages, identify any actions needed to accommodate or notify end users.

8. Monitoring and Reporting

This Section should describe the planned monitoring and reporting program, including all monitoring required by the Program Rules, and include the frequency and location of sampling. Where continuous analysis and recording equipment is used, the method and frequency of calibration should be stated. All water quality sample analyses shall be performed by a certified laboratory.

Below, sample information is provided for different treatment processes, but is not prescriptive or exhaustive as specific requirements will be approved by the state or local agency based on details provided by the Project Applicant in this Engineering Report.

8a. Continuous Process Monitoring

Identify the following:

- Type, location, and frequency of continuous monitoring for treatment process efficacy
- Method and frequency of continuous equipment/instrument calibration

The sample table below should be edited to reflect the monitoring parameters applicable to the ONWS. Additional parameters may be used to effectively operate the ONWS, but may not be required to be logged and reported to the state or local agency as part of the Monitoring Reports or the Annual Report.

8b. Water Quality Analysis

Identify the following:

- Sampling locations and frequencies
- Sample collection approach and personnel training
- Certified laboratory planned for sample analysis (name, address, etc.)

8c.Reporting Requirements

Describe the reporting program.

The following text should be included as applicable:
"A Monitoring Report form shall be provided by state or local agency. Monitoring Reports shall be compiled and submitted [insert frequency based on the Program Rules]. Monitoring Reports shall be signed by the Permittee or Treatment System Manager and submitted by the 15th of the month following the last day of the period reported."

Sample Table 5: Continuous Monitoring Parameters

Parameters	Monitoring Frequency	Reporting Parameters
Example: General AWSS Parameters		
Influent flow rate	Continuous	Daily maximum, minimum, average
Effluent flow rate (Distribution)	Continuous	Daily maximum, minimum, average
LRT achievement	-	Daily yes/no
Effluent BOD5	as required	Sampling results
Total Suspended Solids	as required	Sampling results
pH	Continuous	Daily average
Chlorine residual	Continuous	Daily average
Total Coliform	as required	Sampling results Median of last 7 results
EXAMPLE: Membrane Filtration		
Effluent turbidity	Continuous	Daily maximum, average
Pressure Decay Test	Daily	Daily test pressure, pressure decay results, pass/fail
EXAMPLE: Membrane Bioreactor		
Effluent turbidity	Continuous	Daily maximum, average
Transmembrane pressure	Continuous	Daily maximum, average
EXAMPLE: Reverse Osmosis		
Influent Electrical Conductivity	Continuous	Daily minimum, average
Effluent Electrical Conductivity	Continuous	Daily minimum, average Calculation of minimum removal
EXAMPLE: UV Disinfection		
Flow rate	Continuous	Daily maximum, minimum, average
Influent turbidity	Continuous	Daily maximum, average
Influent UV Transmittance	Continuous	Daily maximum, minimum, average
EXAMPLE: Chlorine		
Free chlorine residual	Continuous	Daily maximum, minimum, average
Flow rate	Continuous	Daily maximum, minimum, average
pH	Continuous	Daily average
EXAMPLE: Ozone		
Ozone residual	Continuous	Daily maximum, minimum, average
Flow rate	Continuous	Daily maximum, minimum, average
Etc.		

9. Contingency Plan

This Section describes the contingency plan designed to prevent inadequately treated alternate water sources from being delivered to the point of end use.

Include the following:

- List of conditions which would require an immediate diversion
- Description of the diversion procedures
- Description of plans for activating of the supplemental water source
- A plan for disposal or treatment of any inadequately treated effluent
- Description of fail-safe features in the event of a power failure or natural disaster
- Plan for notifying users and the state or local agency as appropriate

10. Public Access and Impact

This Section should provide an understanding of the uses of non-potable water to properly evaluate the public exposure and the necessary requirements to protect public health.

10a. Use Areas Overview

This Section should describe the use areas including maps and or plans of any distribution systems.

10b. Customer Notification and Education

This Section should describe the process for customer notification and education regarding the use of non-potable water on the premises.

10c. Public Exposure

In addition to the general information identified above, the following should be provided for the following specific proposed uses:

- Irrigation
    - Method of irrigation and description of what will be irrigated
    - Site containment measures
    - Measures to minimize pooling, overspray, and runoff
    - Protection measures for drinking water fountains and designated outdoor eating areas
    - Proposed irrigation schedule
    - Degree of public exposure and mitigative measures
- Dual-Plumbed Systems (typically toilet and urinal flushing)
    - Pipe locations for both non-potable water and potable water systems
    - Type and location of outlets and plumbing fixtures accessible to the public
    - Degree of public exposure and mitigative measures

10d. Food Facilities (if applicable):

If the development will include food facilities:

- Describe features located within food facilities which will receive non-potable water
- Describe precautions which will be in place to prevent contact with non-potable water

10e. Use Area Signage and Markings

All use areas where recycled water is used that are accessible to the public shall be posted with signs that are visible to the public. Identify the following:

- Color and labeling scheme for non-potable piping
- Sample signage for restroom facilities

- Sample signage for equipment room and valve access panels
- Sample signage for irrigation and other use areas
- Summary list by type including number of signs and location

Appendices

The following is a list of items to be included as Appendices to the submitted Engineering Report.

- Component cut sheets
- Enforceable legal agreement (applicable only to district-scale projects)

Appendix D:
Sample Reporting Documents

Included in this appendix are the following templates:

- Sample Monthly Monitoring Report
- Sample Annual Report

Sample Monthly Monitoring Report

Permit #: _____ Reporting Period: (MM/YYYY): _____

System Address and Phone/Email:

Treatment System Manager: _____

Laboratory: _____

Laboratory Phone/Email: _____

Data: *Attach a Microsoft Excel file containing applicable water quality and operations data as specified in the system's Engineering Report and the Program Rules.*

Operation:

Y	N	1.	Were there any alarms, equipment breakdowns, overflows, bypassing or quality monitoring results in this reporting period?
Y	N	2.	Are any changes planned in the next month that will or has result in a change in character of the source or treated water?
Y	N	3.	Were any calibrations or routine maintenance completed?
Y	N	4.	Were any plumbing changes made in the facility (e.g. new fixtures, repairs, pipe replacements)
Y	N	5.	Are any changes planned in the next month that will or has result in a change in the character of the source or treated water?

If yes to any of the above, attach documentation or logs describing the event and/or circumstances.

For non-operation and/or if end uses were supplied solely by municipal makeup water during the reporting period, state here:

TREATMENT SYSTEM MANAGER MUST SIGN:

Signature: _____ Date: _____

Print Name: _____

I certify, under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

Sample ONWS Annual Report Instructions and Template

All ONWS are required to submit an annual report. The Annual Report should include the all of the elements, tables, and appendices indicated on the templates Table of Contents page as well as a certification statement from the Treatment System Manager that the information provide within the annual report is true, accurate, and complete.

The template is intended to aid ONWS water treatment managers in writing the required annual reports. The template may be restructured and tables and figures should be added as appropriate. *Example wording or directions on the type of information to provide is shown in green italics* and should be modified or supplemented as appropriate. It is acceptable for text to be copied and pasted from previous submissions (including Engineering Reports, Operations and Maintenance manuals, or previous monthly or annual reports).

ONWS Annual Report

<Insert System Location>

<Insert Permit #>

<Insert Principal Treatment System Manager>

Responsible Party/Permittee:
<Insert Name>

<Insert Company Name>

<Insert Company Address>

Prepared by:
<Insert Name>

<Insert Company Name>

<Insert Company Address>

Submitted to:
<Insert State or Local Agency>

Date: *<Insert Date>*

I, as Treatment System Manager, certify that the information and results provided within this report are true, accurate, and complete.

<Insert Signature>

_____

<Insert Treatment System Manager Name>
Treatment System Manager

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Backflow Prevention and Cross-Connection Certification Forms
Discharge Monitoring Reports

1. Operations Overview

This section should provide a general overview of the ONWS including:

- *Facility Information, including type, location, square footage breakdown by usage (residential, office space, etc.), number of occupants, and residential units.*
- *Non-potable water treatment and use system information, including date commissioned, capacity, and identification of any in-house or contractors responsible for maintenance or operation of the system.*

a. ONWS Description

This section describes in detail the water treatment process from collection through use. Include in this discussion the main treatment system components and the purpose of each. If no significant changes have been made, content can be copied and pasted from previously submitted documentation including previous annual reports and the engineering report.

Treatment Modifications

Identify any modifications to the treatment system or changes in the operation of any unit processes or facilities. If none, delete section but include a statement confirming that no treatment modifications or operational changes have been made.

b. Water Sources

This section should include a complete description of the alternate water sources and make-up water sources. Include details on the general character of all water sources. If no significant changes have been made, content can be copied and pasted from previously submitted documentation including previous annual reports and the engineering report.

c. Alternate Water Uses

This section should identify all uses of the alternate water. If no significant changes have been made, content can be copied and pasted from previously submitted documentation including previous annual reports and the engineering report.

For District-scale Systems, include a list of Users and map. Identify if any new users have been added.

d. Operations Personnel

This section should include a list of current operating personnel in charge of maintenance, operations, and system monitoring, including:

- *Contact information*
- *Responsibilities*
- *Corresponding grade, certification, or other training*

e. Contract Laboratory

Identify the laboratories used to complete water quality analyses.

2. Backflow Prevention and Cross-Connection Control

This section should identify all backflow prevention device testing and cross-connection tests and inspections performed in the past year.

a. Backflow Assembly Testing

List or tabulate all backflow prevention devices, date of last test, results, and certified specialist who completed the test.

b. Cross-Connection Certification

Identify any plumbing modifications completed in the past year.

List or tabulate any cross-connection inspections or testing complete, date, results, and certified specialist who completed the test.

3. <Year> Year End Summary

a. System Maintenance

This section should describe all system assessments and maintenance performed in the past year. Include the most recent date completed and who performed the work.

b. Summary of ONWS Flow Records

This section should detail the ONWS flows. Include:

- *Details on influent, effluent, and water system demand/utilization.*
- *A description of any circumstances which may have affected the flows.*

- *If supplemental water was added to the alternate water source system and under what circumstances.*
- *For District-scale Systems, provide a summary of treated non-potable water use by each User.*

Table 1: ONWS Flows, Gallons, <year>

Month	Influent	Effluent (gallons)	Make-up Water	Average Daily Influent	Average Daily Effluent (gallons/day)	Average Daily Make-Up Water	% Effluent Utilized by building
January							
February							
March							
April							
May							
June							
July							
August							
September							
October							
November							
December							
<year>							

c. Outages

Identify any system outages, including reasons and durations.

d. Summary of Alternate Water Quality Analyses

Permit Discharge Monitoring Reports for the past year should be appended to this report to support the summary herein.

Water Quality Sampling and Analyses

This section should describe the system's required water quality monitoring. For each constituent monitored include:

- *Frequency*
- *Acceptable water quality standards*

- *Sample location*
- *If there were any results which were outside of the acceptable water quality standards and if so include the date of the test, the results of THE test, any actions taken to investigate or remediate the situation, and a description of the circumstance found to contribute to the situation, if known.*
- *Fill in a table such as that shown in Table 2 below, substituting appropriate parameters and dates.*
- *Provide additional tables and graphical summaries as appropriate.*

Table 2: Annual Summary of Water Quality Results for *<Year>*

Monthly Mean	*<BOD>* *<(mg/L)>*	*<TSS>* *<(mg/L)>*	*<Total Coliform>* *<(MPN/100mL)>*	*<Turbidity>* *<(NTU)>*	*<Chlorine Residual>* *<(mg/L)>*
January					
February					
March					
April					
May					
June					
July					
August					
September					
October					
November					
December					
Annual Mean: # Samples:*					

*If constituent is monitored continuously indicate as # Samples as "CM".

Summary of Pathogen Log Reduction

This section should describe the verification monitoring and calculations utilized to demonstrate pathogen log reductions through each process as well compliance with any established log reduction targets.

e. Inspections and Enforcement

In this section include a discussion of inspections, any issues with non-compliance or permit violations, enforcement and the corrective action taken.

Inspections

Provide a summary list or table of all inspections initiated by the Producer or SFDPH.

Violations and Corrective Actions

For any non-compliance during the previous calendar year, a description of:

- *Date, duration, and nature of the violation;*
- *Summary of any corrective actions and/or suspensions of non-potable water resulting from a violation; and*
- *If uncorrected, a schedule for and summary of all pending and completed remedial actions;*

f. Permit Modifications

In this section describe all requests to change the conditions of the permit to operate the system since the previous annual report. Describe the requested change and the reason for the change.

g. Operations Manual

In this section indicate any changes to the System's operations manual and the date of the most recent version.

h. Summary

In this section summarize the operations of the system of the year and indicate any mayor events which affected the system.

4. Next Year Projections

Identify:

- *Quantity of non-potable water to be utilized for the next calendar year*
- *Anticipated modifications to the treatment system, including collection or distribution network.*

Appendix E:
BMPs for Storage and Distribution

This appendix includes best management practices for storing and distributing non-potable water. Microbial growth in distribution systems is dependent on the water source and if present, may need to be addressed. The following table is adapted from Sharvelle et al., 2017.

Table E-1
Recommended Approaches for Controlling Microbial Growth in Distribution Systems

Approach	Description
Producing non-potable water low in carbonaceous material and nutrient content	The primary energy source for pathogen regrowth is organic carbon measured as assimilable organic carbon, biodegradable dissolved organic carbon, total organic carbon, and other essential nutrients, including nitrogen (N), phosphorous (P), and iron (Fe); therefore, the primary means to reduce the regrowth potential of pathogens is to provide highly treated water. Reducing the potential for regrowth is more important in large-scale buildings or neighborhood/district-scale projects where there will be more residence time (creating more opportunities for regrowth) in distribution systems that supply non-potable water.
Producing highly disinfected non-potable water	Low concentrations of microbes resulting from filtration and advanced means of disinfection have a reduced potential for regrowth if organic carbon levels are low. Otherwise, there may be a need for a residual disinfectant to manage growth in larger community systems that produce aerosols. Post-treatment disinfection with ultraviolet (UV) radiation is a recommended means of disinfection that does not increase levels of assimilable organic carbon or biodegradable dissolved organic carbon.
Using non-reactive, biologically stable materials of construction	Avoid the use of corrosive materials or organic materials that tend to protect microorganisms from disinfection and enhance the regrowth environment by the adsorption of organic compounds (LeChevallier et al., 1990).
Maintaining a residual disinfectant	Different disinfectants offer advantages and disadvantages to overall water quality and system management. In general, a higher disinfectant residual provides lower regrowth. Many design and operation considerations are available for each specific system. The Panel recommends that a free chlorine residual of 0.2 milligram per liter (mg/L) or chloramine residual of 0.5 mg/L (Cervero-Arago et al., 2015) be maintained at or near the point of use to control microbial growth. Using disinfectant booster stations within the distribution system is one way to ensure adequate disinfectant residuals for systems with long detention times. Chloramine provides a better residual duration as compared to chlorine. Various combinations of UV, chlorine, chloramine, ozone, and hydrogen peroxide are beneficial for specific disinfection goals. Periodic shock treatments with disinfectants and continuous disinfection looping of reservoirs help reduce the potential for regrowth and manage issues with biofilms (LeChevallier, 2003). Stagnation resulting from dead zones or prolonged periods of zero-flow or low flow that create long residence times and allow disinfectants to dissipate and sediments to deposit result in improved conditions for regrowth and should be avoided.
Cleaning storage tanks	The required frequency of storage tank cleaning varies depending upon the quality of water stored, detention time in storage, temperature of the water, and nature of the tank. Tanks that are open to the atmosphere require more frequent cleaning.
Flushing the distribution system	The required frequency of distribution system flushing varies depending upon the quality of water transmitted, detention time in the distribution system, temperature of the water, and nature of the distribution system components. Periodic flushing is a good means of both removing sediments and scouring pipe walls. System design must include means for easily flushing pipes as part of routine maintenance.
Controlling temperature	Avoid the storage and distribution of non-potable water within 20 to 45°C (Health and Safety Executive, 2013d) to reduce the potential for pathogen regrowth. Otherwise, consider a disinfection residual or point-of-use system, particularly if aerosols are generated. Heat recovery from warm waters, particularly graywater and wastewater, can offer the benefit of reducing the temperature at which these waters are stored.

Appendix F:
Considerations for Legionella

Centralized drinking water systems manage enteric (fecal) pathogens relatively well, and the same is true for ONWS if the LRTs described in Chapter 3 are met. The largest recognized cause of waterborne risk from drinking waters in the United States is premise-plumbing growth of *Legionella*, which causes hundreds of millions of dollars in hospitalization costs each year (Collier et al., 2012). The current scientific understanding of *Legionella* growth in piped waters is that most amplification (to problematic concentrations) occurs within amoebae that feed on pipe biofilms (Ashbolt, 2015). A single thermal or disinfection shock may remove biofilm-released pathogens, but not the source of the problem (i.e., the biofilm niche). Hence, new plumbing systems should not be allowed to stagnate prior to use (i.e., between construction and occupants using a system), nor should ongoing systems ignore best management practices until significant biofilm mass develops. At this point, it is too late to control *Legionella* without regular and extensive cleaning protocols. Producing adequate quality non-potable water that meets all the pathogen control criteria set forth in this report is the first step in ensuring proper public health protection. The final step in quality control is to manage properly 1) storage and distribution systems and 2) the uses of non-potable water.

In ONWS, neither significant/routine ingestion nor direct contact with the treated water product is anticipated due to limited exposures to non-potable water. Nevertheless, the occurrence of aerosol inhalation and indirect contact requires the careful management of ONWS storage and distribution systems to control exposures to non-tuberculous mycobacterial and *Legionella* pathogens (Ashbolt, 2015). For example, even clean drinking water may allow biofilm growth of *Legionella* (aerosol pathogen risk) if the water temperature is between 25 to 45°C and stagnates, resulting in the presence of minimal residual chlorine.

The ONWS RME, designer, and operator each should review published guidelines for the management of *Legionella* in distribution systems and implement as appropriate for each specific system. In particular, *ANSI/ASHRAE Standard 188-2015 Legionellosis: Risk Management for Building Water Systems* (2015) provides guidance on best management practices for both potable and non-potable water systems. It addresses management program responsibilities, system design, risk analysis, control mechanisms, monitoring, confirmation, and documentation. The publication *Legionnaire's Disease: The Control of Legionella Bacteria in Water Systems* is a comparable and worthwhile reference that sets forth the Approved Code of Practice in the United Kingdom (Health and Safety Executive, 2013a). Both documents focus on appropriate risk mitigation for potable and non-potable water systems and require analyses of fixtures and uses. Although both the ASHRAE Standard and HSE Code of Practice target legionellosis, their rationales and approaches are applicable to all pathogens and health risks identified in this report.

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