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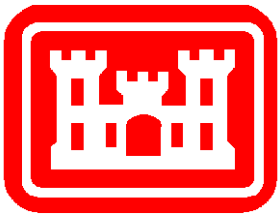
APPLICABLE GUIDELINES FOR WATER REUSE AT ARMY INSTALLATIONS



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APPLICABLE GUIDELINES FOR WATER REUSE AT ARMY INSTALLATIONS

1. Purpose

a. This Public Works Technical Bulletin (PWTB) serves as a starting-point guide for those Army installations that are considering water reuse applications. It provides general guidelines for water reuse, lists types of water reuse, offers potential concerns for water reuse systems, and provides links to state-specific information on water reuse.

b. All PWTBs are available electronically at the National Institute of Building Sciences' Whole Building Design Guide webpage at:

http://www.wbdg.org/ccb/browse_cat.php?o=31&c=215

2. Applicability

This PWTB applies to all continental (CONUS) Army installations and lands. To the extent referenced, this PWTB is also relevant to outside CONUS (OCONUS) Army installations and lands under Army jurisdiction.

3. References

a. Clean Water Act, United States Code (U.S.C.) 33:1251-1384 (Public Law [PL] 95-217), "Navigation and Navigable Water," 27 December 1977.

b. Safe Drinking Water Act, contained in U.S.C. 42:300f (Chapter 6A – Public Health Service), 1974, as amended in 1986 and 1996.

c. Executive Order (EO) 13423, “Strengthening Federal Environmental, Energy, and Transportation Management,” 24 January 2007.

d. EO 13514, “Federal Leadership in Environmental, Energy, and Economic Performance,” 8 October 2009.

e. Army Regulation (AR) 200-1, "Environmental Protection and Enhancement," revised 13 December 2007.

f. AR 420-1, “Army Facilities Management,” 12 February 2008.

g. Memorandum, “Water Goal Attainment Responsibility for Installations,” Assistant Secretary of the Army Installations, Energy and Environment (ASA [IEE]), 20 December 2012.

h. “Army Vision for Net Zero.” 2010. Washington, DC: ASA (IEE), Katherine Hammack. http://army-energy.hqda.pentagon.mil/programs/netzero.asp

i. State statutes and regulations of all 50 U.S. states.

4. Discussion

a. Within the United States, the US Army has jurisdiction over and manages more than 12 million acres of land and over 200 Army installations (along with hundreds of National Guard facilities). These lands and installations extend over numerous (and often multiple) federal, state, and local governmental jurisdictions. Management and conservation of water resources is implicit with management and stewardship of those resources. Management of water resources also affects long-term installation and mission sustainability, ecological function and integrity, and human health and well-being.

b. In part because of increasing demands from public and private sectors for ground and surface water resources, wise and effective use of water resources is becoming increasingly important. Conservation and management of water resources can involve water reuse strategies. Water reuse also can extend water supplies and support alternative wastewater disposal methods.

c. The Clean Water Act (CWA) and Safe Drinking Water Act (SDWA) are the primary federal statutes addressing water reuse. These laws, along with state and local laws (and their implementing regulations), establish standards for water quality and limit contaminant and pollutant discharges. These laws also establish standards for waters associated with Army installations and other federal properties.

d. In October 2009, EO 13514 enhanced EO 13423 by setting new goals for federal agencies to:

(i) Reduce potable water consumption intensity by 2% annually through FY20 or 26% by the end of FY20, relative to a baseline of the agency's water consumption in FY07, by implementing water management strategies including water-efficient and low-flow fixtures and efficient cooling towers.

(ii) Reduce agency industrial, landscaping, and agricultural water consumption by 2% annually or 20% by the end of FY20, relative to a baseline of the agency's industrial, landscaping, and agricultural water consumption in FY10.

e. AR 200-1 sets forth policy, procedures, and responsibilities for the conservation, management, and restoration of land and natural resources that are consistent with the military mission and in accordance with national laws and policies. Chapter 4-2 of AR 200-1 requires compliance with applicable federal, state, and local laws and regulations regarding water resources management. The objective is to ensure the availability, conservation, and protection of water resources. It encompasses water supply and pollution abatement at fixed and field facilities. Other requirements are to participate with regional authorities in the development and implementation of water resource initiatives and to encourage the beneficial reuse of wastewater and sludge. Plans/programs are required to safeguard drinking water quality and quantity, both at the source and in the distribution system, which includes water conservation measures.

f. AR 420-1 addresses the management of Army facilities. Chapter 22 addresses the Army Energy and Water Management Program and prescribes policies, procedures, and responsibilities for the Army Energy and Water Management Program (AEWMP). The overall objective of the AEWMP is to ensure the availability, quality, and security of energy and water for the Army without degrading the environment, mission readiness, or the well-being of Soldiers. Section 22-4 provides implementing guidance infusing energy and water efficiencies into the development of Army operations, processes, procedures, acquisition strategies, and other mission-related functions.

Section 22-9 requires energy and water savings technologies to be used and procured, and Section 22-12 requires increased water efficiency, conservation awareness, leak surveys, water audits, and plans for implementation of best management practices such as water reuse. It includes a requirement to use reclaimed or recycled water for landscape irrigation.

g. The Army Vision for Net Zero embraces the sustainability ethos and federal mandates on resource conservation wholeheartedly with a Net Zero Installation initiative focused on energy, water, and waste. A Net Zero Water Installation limits the consumption of freshwater resources and returns water to the same watershed so as not to deplete the groundwater and surface water resources of that region in quantity and quality over the course of a year. The net zero water strategy balances water availability and use to ensure sustainable water supply for years to come. This concept is of increasing importance since scarcity of clean potable water is quickly becoming a serious issue in many countries around the world. The continued draw-down of major aquifers results in significant problems for our future. Strategies such as harvesting rainwater and recycling treated wastewater for reuse and desalination can be used to increase available water supply. To achieve a net zero water installation, efforts begin with conservation followed by efficiency in use and improved integrity of distribution systems. Water is repurposed by utilizing grey water generated from sources such as showers, sinks, and laundries and by capturing precipitation and storm water runoff for on-site use. Wastewater can be treated and reclaimed for other uses or recharged into groundwater aquifers. Several Army installations were already well down the path to reaching net zero water goals, and others are progressing.

h. Federal laws do not address water reuse directly, but impact reuse of water in many ways such as through the Safe Drinking Water Act and the Clean Water Act. The US Environmental Protection Agency (USEPA) has primary oversight for their implementation which in turn has been delegated to the majority of states. The USEPA has suggested guidelines for reuse of municipal wastewater, which may be adopted or adapted by individual states. In Appendix A of this PWTB, appropriate material is extracted from the USEPA document and adapted for application at Army facilities and installations.

i. As for water reclamation, there are no federal regulations governing water reclamation and reuse; regulations for water reclamation are developed and implemented at the state government level. This lack of federal regulation has resulted

in differing standards among those states that have developed water reuse regulations.

j. It should be noted that the absence of state regulations and guidelines for specific reuse applications does not necessarily prohibit water reuse. Many states evaluate specific types of water reuse on a case-by-case basis. Thus, some states have regulations, others have guidelines, and still others have no policy. In 2012, approximately 25 states have regulations addressing water reuse, 16 have guidelines, and 9 have neither. Understanding the difference between regulations and guidelines is important. Regulations are legally adopted, enforceable, and mandatory, while guidelines are advisory, voluntary, and non-enforceable but can be incorporated in water reuse permits, thereby becoming enforceable requirements. Some states prefer the use of guidelines to provide flexibility in regulatory requirements depending on project-specific conditions. This flexibility may result in differing requirements for similar uses. State laws by definition must conform to federal law. In those states with implementation laws and regulations for the Clean Water Act and other federal laws, state regulations apply. In other states without specific water reuse regulations, general state laws and regulations apply.

k. Water reuse must generally be authorized at the state level through a water reuse application processes. Broadly speaking, water reuse can be for urban, industrial, agricultural, environmental, or recreational purposes, or for contributing to groundwater recharge for potable water supplies. This PWTB focuses on reuse of reclaimed wastewater (treated municipal wastewater effluent). Reuse of graywater (water from laundries and bathing), internal recycling of various water qualities, rainwater harvesting, and general water efficiency are not covered in this PWTB, but have been covered previously by PWTB 200-1-75, 200-1-101, 200-1-104, and 200-1-105 (Scholze 2010, 2011a, 2011b, 2011c). The table below defines water reuse terminology as used in this PWTB (Scholze 2011d).

Term	Definition
Blackwater	Water captured from toilets and urinals along with kitchen waste.
Direct potable reuse	The introduction of highly treated, reclaimed water either directly into the potable water supply distribution system downstream of a water treatment plant or into the raw water supply immediately upstream of a water treatment plant.
Graywater*	Water captured from sinks, baths, showers, and residential laundries that can be treated and reused. It generally does not include water from kitchen sinks or dishwashers. *

Term	Definition
Indirect potable reuse	The planned incorporation of reclaimed water into a raw water supply, such as in potable water storage reservoirs or groundwater aquifer, resulting in mixing and assimilation, thus providing an environmental buffer.
Rainwater harvesting	Runoff captured from rooftops or other hard surfaces that can then be used for beneficial use after minimal treatment.
Reclaimed water	Municipal wastewater that has gone through various treatment processes to meet specific water-quality criteria with the intent of being used in a beneficial manner such as irrigation. The term recycled water is often used synonymously with reclaimed water.
Wastewater	Used water discharged from homes, businesses, and industry.
Water reuse	The use of treated wastewater for a beneficial use, such as irrigation or industrial cooling.
* Some organizations accept a definition of "graywater" that does include kitchen and dishwasher waste water along with wastewater from soiled diaper washing. This graywater has higher levels of risk.	

l. Urban water reuse can include lawn, landscape, and school yard irrigation, washing facilities, dust control, fire protection, and sanitary sewer flushing. Industrial reuse can include cooling, boiler make-up, industrial chemical or paint stripping processes, and concrete manufacturing. Agricultural reuse is almost exclusively irrigation-related. Environmental applications for water reuse include those involving wetlands (including wetland construction) and stream augmentation. Recreational uses can include lakes and ponds for boating, and fountains in parks for aesthetics. Groundwater recharge applications of reused water are frequently used as a method of treatment and to provide for future retrieval and reuse. For example, a common example of indirect potable water reuse is where highly treated effluent is discharged to surface water supplies and then withdrawn to be used in potable water treatment.

m. The water reuse examples provided above are not all-inclusive. Rather, they are examples of different categories of water reuse. In all instances, appropriate state agencies, statutes, and regulations should be consulted and followed. In some jurisdictions, other government units such as the county or municipality may have regulations related to water reuse. For example, some counties may have regulations addressing the application of diluted animal waste and municipalities generally have related plumbing codes.

n. There are many considerations for water reuse strategies, methods, and applications. These considerations include current water use as well as availability and demand; competing, existing, or anticipated local, regional, or state needs; pollution and contaminant criteria and control; public health

concerns; available treatments; delivery systems; treatment systems; overall infrastructure; and cost, with cost-to-benefit analysis.

o. Public health is often the major consideration for water reuse. For that reason, water reuse guidelines and regulations are directed primarily at protecting the public health. For nonpotable water reuse applications, the criteria generally address only microbiological and environmental concerns. Of course, health risks (associated with both pathogenic microorganisms and chemical constituents) need to be addressed where reuse water will augment a potable water supply.

p. Reuse water quality requirements are based on proper controls and safety precautions implemented at areas where the water is used. Depending on water quality and type of use, controls may include warning signs, color-coded pipes and appurtenances, fencing, confinement of the water to approved areas of use, cross-connection control provisions, and other public health protections.

q. Reuse requirements also will include specific physical and chemical water quality requirements, even when they are not related to health considerations. Similarly, it is important that irrigation applications consider the effect of individual constituents or parameters on crops or other vegetation, soil, and groundwater or other receiving water. Physical, chemical, and/or microbiological quality may limit user or regulatory acceptability regarding specific uses. Water quality requirements not associated with public health or environmental protection are seldom included in water reuse criteria by regulatory agencies.

r. The natural flora and fauna around an area and the receiving waters where reuse water is used should not be adversely impacted by the reuse water.

s. High-level nonpotable water uses such as toilet flushing and urban irrigation require reuse water which is similar in appearance to potable water — clear, colorless, and odorless. For recreational impoundments, reuse water should not promote algal growth.

t. Regulatory agencies take into account the costs that regulations impose on reclaimed water producers and users. They are prone to set standards thought to be safe, but that do not lower health or environmental standards for the sole purpose of making projects economically attractive.

u. On the other hand, political realities may impact regulatory decisions regarding water reuse. Factors such as public policy, public acceptance, technical acceptance, and financial considerations may also apply.

v. This PWTB summarizes the applicable state-level regulations and standards pertaining to ongoing and potential water reuse on Army installations and properties. In preparing this summary, effort was made to provide consistency in the review and summarization of applicable laws and regulations between states. In order to be reasonably concise, this summary focuses on areas where water reuse is likely to take place on Army installations; therefore, agricultural reuse is not specifically covered. Agricultural reuse is a major category and has a wide variety of state regulations and guidelines, many very specific to the type of crops being planted. Therefore, it is advisable to contact individual states for these potentially more stringent water reuse requirements. For example, while agricultural water reuse for food crops and non-food crops is generally permitted, more stringent requirements exist for food crop uses. Similarly, some states differentiate between unrestricted and restricted water reuse for recreational purposes. Herein, we summarize unrestricted reuse applications, as those are potentially more relevant to Army situations. In addition, because of varying state laws and the construction of state regulations, some interpretation was necessary. For example, some states do not specifically address water reuse. However, even in these instances, states have basic water quality, discharge, and other criteria that may apply to water reuse.

w. In all situations, proponents of water reuse should consult with the designated state and local government authority for more general as well as case-specific and project-specific information, requirements, and application.

x. Appendix A provides details of current water reuse practices and state guidance, based largely on US EPA 2012 guidelines.

y. Appendix B provides links to websites on water reuse maintained by each state, as updated by the WateReuse Association.

z. Appendix C provides reference information for printed material cited, additional useful resources on water reuse, and spell-outs of abbreviations used in this PWTB.

5. Points of Contact

a. Headquarters, US Army Corps of Engineers (HQUSACE) is the proponent for this document. The point of contact (POC) at HQUSACE is Mr. Malcolm E. McLeod, CEMP-CEP, 202-761-5696, or e-mail: Malcolm.E.Mcleod@usace.army.mil.

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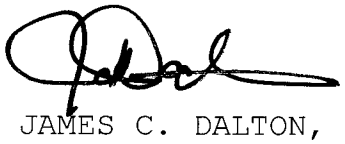

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APPENDIX A: WATER REUSE

The USEPA released Guidelines for Water Reuse (USEPA 2012) which updates its 2004 guidance. The new guidelines reflect great expansion in the field of water reuse and contain new applications and advances in technology along with updates in state regulatory information.

In addition to this overview of guidelines, other PWTBs offer guidance to Army installations on various aspects of water reuse (Scholze 2010, 2011a, 2011b, 2011c).

Water reuse is defined as the use of treated wastewater for a beneficial use, such as irrigation or industrial cooling. Reclaimed water is domestic wastewater that has gone through various treatment processes to meet specific water quality criteria with the intent of being used in a beneficial manner such as irrigation. The term recycled water is often used synonymously with reclaimed water. Sometimes all three of these phrases may be used synonymously.

While increased use of reclaimed water typically poses greater financial, technical, and institutional challenges than using traditional sources, a range of treatment options are available. These options mean that any level of water quality can be achieved, depending on the use of the reclaimed water. This continuum of reuse practices is called "fit for purpose," meaning that water is treated only to the needed level, depending on the end application, to achieve economic efficiency and environmental sustainability.

Water scarcity and demand are causing people to turn to reuse as an alternative, particularly in arid and semiarid regions. However, many other water reuse programs in the United States have been initiated in response to requirements to remove nutrients (nitrogen and phosphorous) before disposal of effluent to surface water. Water reuse has also been used to maintain environmental baseline flows for sensitive ecosystems.

Planning for Water Reuse

Planning a water reuse system requires consideration of a number of steps. This would be true for a municipal type of system, which is either an installation-wide system or one that combines with nearby municipalities. On the other hand, an activity-specific reuse would require significantly less planning. An industrial process recycling system would have different process

control drivers. Thus, the planning process should be consistent with overall water resource management objectives.

A water reuse plan can identify installation uses for reclaimed water, potential users, user demands, and the quality of water required. It is also essential to determine the volume of water available for distribution and the ability to meet instantaneous demands.

During the planning process, it is critical to examine federal and state laws, regulations, rules, and policies. In addition, certain federal and state natural resource and environmental impact laws apply at the planning stage. For example, the National Environmental Policy Act (NEPA) requires an assessment of environmental impacts for all projects receiving federal funds and subsequent mitigation of all significant impacts. Many states have equivalent rules and often require a public review. Other legal considerations in establishing a reuse system include applicable plumbing codes and requirements impacting pipe placement as well as the distances separating potable water lines and sewer lines from the reclaimed water system. Other laws protect biological, scenic, and cultural resources. This protection may preclude new water resource development (e.g., dams) that will make reuse more attractive.

The WateReuse Association’s Manual of Practice (WateReuse 2009) provides project-planning steps which are listed below. (Further details are available in the manual.)

1. Identify quantity of reclaimed water available.
2. Screen all existing and potential future uses and users.
3. Identify potential users.
4. Determine if users will accept reclaimed water.
5. Compare supply to potential demand.
6. Prepare distribution system layout.
7. Finalize customer list.
8. Determine economic feasibility.
9. Compile final user list and distribution.
10. Prepare point-of-sale facilities.

11. Obtain regulatory approval.

12. Perform on-site retrofits.

13. Perform cross-connection test.

14. Begin delivering water.

Irrigation of golf courses and recreational areas are the best-known applications for reuse water, but a number of applications may provide significant savings in potable water: toilet flushing, industrial fire protection, stream restoration/augmentation, cooling towers, and many other uses. The most reliable customers will be those who can utilize nonpotable water daily throughout the year, as they will supply a baseline usage.

Managing Water Reuse

Managing reclaimed water supplies may be significantly different from managing traditional water sources. Depending on the volume and pattern of reuse demands, there may be seasonal storage requirements in addition to storage required for operations. Where water reuse is being implemented to reduce or eliminate wastewater discharges to surface waters, state or local regulations usually require that adequate seasonal storage be provided to retain excess wastewater under a specific return period of low demand. This wastewater storage could result in a National Pollution Discharge Elimination System (NPDES) permit violation. In many cases, state regulations will include a discussion about methods to be used for calculating storage requirements.

Managed aquifer recharge is an area of water reuse which merits extra attention. Aquifer recharge has a long history in the United States, over 50 years in some cases, as a method to replenish groundwater basins, create salt water intrusion barriers, and mitigate negative impacts of subsidence caused by over-withdrawal of groundwater. The two primary types of groundwater recharge are surface spreading and direct injection. Vadose zone injection wells have increased in use as this technology has become more established. Aquifer recharge has been successfully conducted at US Army installations. It is essential that appropriate permits be obtained from the state.

Water quality considerations are important depending on the method and purpose of groundwater recharge. Most states require either a minimum of secondary or tertiary treatment of water

used for groundwater recharge. State Underground Injection Control programs and Sole Source Aquifer Protection are included under the Safe Drinking Water Act (SDWA) which provides safeguards so that aquifer recharge and Aquifer Storage and Recovery (ASR) wells do not endanger current and future underground sources of drinking water. There is no specific requirement for nutrient removal, but lower effluent nutrient concentrations that are required for point source discharges could also meet strict nutrient groundwater recharge requirements. In many cases, wells used for injection and recovery of reclaimed water are classified by the EPA as Class V injection wells, and some states (e.g., California and Florida) require that the injected water must meet drinking water standards prior to injection, depending on the native quality of water in the aquifer being recharged.

Surface spreading is the most widely-used method of groundwater recharge due to its high loading rates and relatively low maintenance requirements.

Distribution System Safeguards for Public Health Protection in Nonpotable Reuse

Where water reuse applications are designed for indirect or direct potable reuse, treatment is designed to achieve the level of purity required for potable reuse. Where reclaimed water is intended for nonpotable applications, water quality must protect public health. In addition to appropriate water quality requirements, other safeguards must be used to protect public health even in nonpotable reuse.

When reclaimed water is intended for nonpotable reuse, the major priority in design, construction, and operation of a reclaimed water distribution system is the prevention of cross-connections. A cross-connection is a physical connection between a potable water system used to supply drinking water and any source containing nonpotable water through which potable water could be contaminated. To protect public health from the outset, a reclaimed water distribution system should be accompanied by the following protection measures (USEPA 2012).

- Establish that public health is the overriding concern.
- Devise procedures and regulations to prevent cross-connections and misuse, including design and construction standards, inspections, and operation and maintenance staffing.

- Ensure the physical separation of the potable water, reclaimed water, sewer lines, and appurtenances in design and construction.
- Develop a uniform system to mark all nonpotable components of the system.
- Devise procedures for approval (and disconnection) of service.
- Establish and train special staff members to be responsible for operations, maintenance, inspection, and approval of reuse connections.
- Provide for routine monitoring and surveillance of the nonpotable system.
- Prevent improper or unintended use of nonpotable water through a proactive public information program.

Processes for permitting water reclamation and reuse projects differ from state to state. Basic procedures generally include plan and field reviews followed by periodic inspections. Piping at the site of use also may be controlled by local plumbing code. In addition, some states specify the type of identification required to distinguish system separation such as tags, labeling, or specific coloring. Generally, all piping, pipelines, valves, and outlets must be color-coded or otherwise marked. Quality assurance and monitoring programs should be specified. Monitoring programs must establish goals for reclaimed water treatment performance and distribution system water quality, provide monitoring to verify conformance with the goals, and establish appropriate actions if goals are not achieved. States vary in how they approach monitoring requirements and individual installations need to contact the appropriate state agencies. For example, Texas requires monitoring for reclaimed water based on the intended use and not on the treatment process utilized to produce reclaimed water. In this case, Type I use is where contact with humans is likely, such as irrigation, recreational water impoundments, firefighting, and toilet flushing; Type II use is where contact with humans is unlikely, such as outdoor use at a site restricted to limited human contact (USEPA 2012).

Graywater Reuse

A general overview of graywater in relation to the Army was presented in a previous PWTB 200-1-101 (Scholze 2011a). A section is presented here to introduce recent material including an American National Standards Institute (ANSI) standard published by NSF International in 2011.

Graywater is untreated wastewater, excluding toilet, dish washer, and kitchen sink wastewaters. Graywater does include wastewater from bath tubs, showers, bathroom wash basins, washing machines, and laundry tubs. Graywater reuse has been seen as a potential solution to water shortages and an assist to water efficiency.

Key to viability of small or on-site graywater systems is an effective policy, permitting, and regulatory process to provide adequate treatment of graywater for its intended end use. In many states, the regulatory system is still designed for large-scale systems; the permitting process for small systems is complex because small systems cross the purview of various regulatory agencies which can cause hurdles in the approval process. There are a number of states and local agencies that provide specific regulations or guidance for graywater use, including Arizona, California, Connecticut, Colorado, Georgia, Massachusetts, Montana, Nevada, New Mexico, New York, Oregon, Texas, Utah, Washington, and Wyoming. Other states and local building codes may not allow graywater use in a given locale.

In addition to government-based regulation, there are institutional policies such as the Uniform Plumbing Code (UPC) and International Plumbing Code (IPC) that are applicable to implementing graywater systems. New standards were developed in 2011: NSF/ANSI Standard 350,[1] “Onsite Residential and Commercial Water Reuse Treatment Systems” and NSF/ANSI Standard 350-1,[2] “Onsite Residential and Commercial Graywater Treatment Systems for Subsurface Discharge.” The standards provide detailed methods of evaluation; product specifications; and criteria related to materials, design and construction, product literature, wastewater treatment performance, and effluent quality for on-site systems. Graywater disposal at a residential site generally requires a permit, usually from the local county or other representative public health department. If the volume exceeds a certain limit, an NPDES permit may be required from the state or county government if responsibility has been delegated to that level.

Appropriate end uses for reclaimed water from on-site systems include indoor restricted urban water use (e.g., toilet flushing) and outdoor unrestricted urban use (e.g., surface irrigation). The Standard 350 effluent criteria (summarized in

[1] http://www.nsf.org/business/wastewater_certification/standard350.asp?program=WastewaterCer

[2] http://webstore.ansi.org/RecordDetail.aspx?sku=NSF%2FANSI+350-1-2011

Table A-1) are applied consistently to all treatment systems regardless of size, application, or influent quality. Effluent criteria in the table must be met for a system to be classified as either a residential treatment system for restricted indoor and unrestricted outdoor use (Class R) or as a multi-family and commercial facility water treatment system for restricted indoor and unrestricted outdoor use (Class C). For subsurface discharges from large systems, criteria in Table A-2 are recommended; these standards may be applicable to Army installations, depending on local governing authority. Clarification of terms used in this table is given in text following the table.

Table A-1. Summary of NSF Standard 350 Effluent Criteria for individual classifications (Table 2-5 in USEPA 2012).

	Class R		Class C	
Parameter	**Test Average**	**Single Sample Maximum**	**Test Average**	**Single Sample Maximum**
$CBOD_5$ (mg/L)	10	25	10	25
TSS (mg/L)	10	30	10	30
Turbidity (NTU	5	10	2	5
E coli[2] (MPN/100 mL)	14	240	2.2	200
pH (SU)	6.0 – 9.0	NA[1]	6.0 – 9.0	NA
Storage vessel disinfection (mg/L)[3]	≥0.05 – ≤2.5	NA	≥0.05 – ≤2.5	NA
Color	MR[4]	NA	MR	NA
Odor	Nonoffensive	NA	Nonoffensive	NA
Oily film and foam	Nondetectable	Nondetectable	Nondetectable	Nondetectable
Energy consumption	MR	NA	MR	NA

[1] NA: not applicable; [2] Calculated as geometric mean; [3] As total chlorine; other disinfectants can be used; [4] MR: Measured reported only

- **$CBOD_5$** stands for carbonaceous biochemical oxygen demand. It is a method defined test measured by the depletion of dissolved oxygen by biological organisms in a body of water in which the contribution from nitrogenous bacteria has been suppressed. CBOD is a method defined parameter widely used as an indication of the pollutant removal from wastewater of organic matter.

- **TSS** stands for total suspended solids and is a water quality measurement referring to the dry weight of particles trapped by a filter.

- **Turbidity** is the cloudiness or haziness of a fluid caused by individual particles. For water quality it is measured by using a calibrated nephelometer and expressed in nephelometric turbidity units (NTU). Particles in the water will scatter when a light beam is focused on them, and the nephelometer is set up with a detector to the side of the light beam.

- **E. coli** (*Escherichia* coli) is a type of fecal coliform bacteria commonly found in the intestines of animals and humans. The presence of E. coli in water is a strong indication of recent sewage or animal waste contamination. In the water treatment industry, its presence is used as a measure of potential enteric pathogens.

- **Storage vessel disinfection** is measured as milligrams per liter (mg/L) and generally uses various forms of chlorine as the disinfectant. Other possible disinfectants include ultraviolet light and ozone.

- **Test Average** is defined as the overall average for all samples within the testing time period established by Standards 350 and 350-1. This average is based on 26 weeks, with a typical 3-day per week sampling schedule.

Table A-2. Summary of ANSI/NSF Standard 350-1 for subsurface discharges (Table 2-6 in USEPA 2012).

Parameter	Test Average
$CBOD_5$ (mg/L)	25 mg/L
TSS (mg/L)	30 mg/L
pH (SU)	6.0 – 9.0
Color	MR[1]
Odor	Non-offensive
Oily film and foam	Non-detectable
Energy consumption	MR

[1] MR: Measured reported only

Types of Reuse Applications

The major categories of water reuse applications are: urban, agricultural, recreational, environmental, industrial, and nonpotable. Examples for some of these are shown in Table A-3.

Table A-3. Water reuse categories and typical applications.

Water Reuse Category	Typical Application
Irrigation	Parks School yards Highway medians Golf courses Cemeteries Parade grounds Athletic fields Building landscapes Crops or vegetable gardens
Industrial recycling and reuse	Cooling water Boiler feed Process water Construction
Groundwater recharge	Groundwater recharge Saltwater intrusion control Subsidence control
Recreational/environmental uses	Lakes and ponds Marsh enhancement Streamflow augmentation Fisheries
Nonpotable urban uses	Fire protection Dust suppression Air conditioning Toilet flushing Water features

Urban Reuse

Urban reuse is one of the highest volume reuse types in the United States, with many states having regulations that address it. For purposes of this document, urban reuse applies to the cantonment portion of an installation.

Urban reuse applications such as recreational field, parade ground, cemetery, golf course, and landscape irrigation along with other applications, including fire protection and toilet flushing, are important components of many urban reclaimed water programs. Urban reuse is often divided into applications that are either accessible to the public or have restricted access.

Public access is often controlled by physical or institutional barriers, such as fences or temporal access restriction (e.g., waiting period). One of the major ways to maximize water efficiency is to irrigate with nonpotable reclaimed water instead of potable water. Also, overseas contingency bases (e.g., in Afghanistan) can use treated graywater for dust suppression, provided it has met appropriate levels of treatment and has the approval of the Public Health Command representative on site.

When used to irrigate golf courses, parade grounds, landscaped areas, and athletic fields, the reclaimed water receives treatment and high-level disinfection so its use is not considered a threat to public health. However, the nutrient quality of reclaimed water differs from that of potable water or rainfall, and this difference should be considered when using reclaimed water for irrigation and other reuse applications. Of particular importance are the salts and nutrients in reclaimed water, which may require special management practices depending on the concentrations in the reclaimed water. For example, with some landscaping irrigation, salt sensitivity of the irrigated plants should be considered. Many golf courses in the Southwest and Southeast use reclaimed water. Harivandi (2011), a specialist in golf course turf, has summarized water quality factors to monitor for turfgrass irrigation in Table A-4. For reclaimed waters, slight-to-moderate use restrictions would apply when water-quality parameters exceed the ranges indicated in Table A-4. Terms used in this table are explained in text that follows.

Table A-4. Interpretation of reclaimed water quality (Table 1 from Harivandi 2011).

Parameter	Units	Degree of Restriction on Use		
		None	Slight to Moderate	Severe
Salinity				
EC_w	dS m^{-1}	< 0.7	0.7 – 3.0	> 3.0
TDS	mg/L	< 450	450 – 2,000	> 2,000
Sodium (Na)				
Root Absorption	SAR*[1]	< 3	3-9	> 9
Foliar Absorption	mg/L	< 70	> 70	-
Chloride (Cl)				
Root Absorption	mg/L	< 70	70 – 355	> 355
Foliar Absorption	mg/L	<100	> 100	
Boron	mg/L	< 1.0	1.0 – 2.0	> 2.0
pH (normal range)			6.5 – 8.4	

*SAR = Sodium Adsorption Ratio

- **Salts** in irrigation water are a major concern, and evaluation of the impact of the water on the crop is essential. Salinity hazard is a calculation of the total soluble salt content in the water. Sodium hazard indicates the relative proportion of sodium to calcium and magnesium ions.

- **Water salinity** hazard is measured by electrical conductivity of the irrigation water (**Ecw**). The primary effect of high Ecw water on crop productivity is the inability of the plant to compete for water (physiological drought). The higher the Ecw, the less water is available to plants, even though the soil may appear to be wet. Ecw is an indirect measurement of ions by an electrode, and it measures salinity from all the ions dissolved in a sample. The preferred unit for this measurement is deciSiemens per meter (dS/m); however, other units are used and conversions are available.

- Although plant growth is primarily limited by salinity level of the irrigation water, the application of water with sodium imbalance may further reduce yield under certain soil texture conditions. This reduction can occur when irrigation water contains high sodium relative to the calcium and magnesium contents. This condition, termed **sodicity**, results from excessive soil accumulation of sodium. Sodicity causes swelling and dispersion of soil clays, surface crusting, and pore plugging. The degraded soil structure condition obstructs infiltration and may increase runoff. The most common measure to assess sodicity in water and soil is called the SAR (sodium adsorption ratio). SAR is a measure of the suitability of water for use in agricultural irrigation as determined by the concentrations of solids dissolved in the water. In general, the higher the SAR, the less suitable the water is for irrigation.

- Sometimes dissolved ions or salts such as sodium, magnesium and calcium are measured in **milli equivalents per liter** (meq/L) rather than mg/L. The meq/L unit of measure reflects the capacity of ions to react with one another: meq/L = mg/L divided by atomic weight of ion divided by ionic charge.

- **Root absorption** measures absorption of water and nutrients/chemicals through roots.

- **Foliar absorption** measures absorption of water through the leaves.

- **Chloride** is a common ion in many reuse waters used for irrigation. Although chloride is essential to plants in very low amounts, it can cause toxicity to sensitive crops at high concentrations.

- Boron is an element that is essential in low amounts, but toxic at higher concentrations.

- Local irrigation authorities should also be contacted as method of application can make a difference in leaf burn.

USEPA (2012) lists the following practices to minimize water quality impacts for golf courses. Considerations for other urban areas are much like those for golf courses.

- applying extra water to leach excess salts below the turfgrass root zone
- providing adequate drainage
- modifying turf management practices
- modifying the root zone mixture
- blending irrigation waters
- using amendments

Agricultural Reuse

Agricultural reuse is a potential for installations, as many of them have active agricultural programs on site. Different regional and governmental agencies have adopted a variety of standards to use reclaimed water for agricultural crop irrigation. These rules and regulations have been developed primarily to protect public health and water resources, but specific crop water-quality requirements must be developed with the end users. The standards adopted in the United States have proven effective for public health in spite of vast differences in their stringency. This document will only address these standards in a cursory approach as there is limited agriculture on Army installations. Limited guidance, however, is presented in state-specific tables, and the interested reader is referred to USEPA 2012 for additional information.

Recreational Reuse

Impoundments

Recreational and landscape impoundments vary in the quality of reclaimed water which can be sent to them. Regulation typically follows potential for human contact for the particular end use. For example, in Arizona, reclaimed water that is used for recreational impoundments where fishing or boating is an intended use must meet Class A requirements. These requirements include secondary treatment, filtration, and disinfection so that no detectable fecal coliform organisms are present in four of the last seven daily reclaimed water samples taken and no single sample maximum concentration of fecal coliform organisms (e.g., E.coli) exceeds 23/100 ml. In impoundments where body contact is prohibited such as a facility for landscaping or aesthetic purpose only, less stringent requirements may apply.

Snowmaking

Some states regulate snowmaking from reclaimed water as "recreational body-contact water," but vary in their approach. In most states, use of reclaimed water for snowmaking is either regulated or managed as a winter-time disposal option or as a reuse option, but seldom both. Some states which do regulate the use of snowmaking with reclaimed water include Arizona, California, Colorado, Maine, New Hampshire, and Pennsylvania.

Environmental Reuse

Environmental reuse primarily includes the use of reclaimed water to support wetlands and to supplement stream and river flows. Aquifer recharge may also be considered an environmental reuse. Application of reclaimed water serves to restore and enhance wetlands that have been hydrologically altered. New wetlands can be created through application of reclaimed water, resulting in a net gain in wetland acreage and function. In addition, constructed and restored wetlands can be designed and managed to maximize diversity within the landscape.

Natural wetlands, which are considered waters of the United States, are protected under the USEPA's NPDES Permit and Water Quality Standards programs and in state requirements. The quality of reclaimed water entering natural wetlands can thus be regulated by federal, state, and local agencies, and it must be treated to secondary treatment levels or greater. On the other hand, constructed wetlands are not considered waters of the

United States because constructed wetlands are built and operated for the purpose of treatment.

Environmental reuse also includes river or stream augmentation to reduce demand on aquifer and surface water supplies. River and stream augmentation differs from a surface water discharge in several ways. Augmentation seeks to accomplish a benefit, such as aesthetic purposes or enhancement of aquatic or riparian habitat, whereas discharge is primarily for disposal. River or streamflow augmentation may provide an economical method of ensuring water quality, as well as having other benefits. It can minimize the challenge of locating a reservoir site; the additional water can improve the overall water quality of the receiving water body; and the effect of low-flow drought conditions can be mitigated by providing high-quality water at the time of greatest need. River and stream augmentation may also reduce or eliminate water-quality impairment and may be desirable to maintain streamflows, to enhance the aquatic and wildlife habitat, and to maintain the aesthetic value of the water courses. As with impoundments, water quality requirements for river or stream augmentation will be based on the designated use of the water course and the aim to enhance an acceptable appearance. Some states have guidelines or regulations that provide requirements for reclaimed water quality and monitoring to protect wetlands; requirements for reclaimed water quality for augmenting rivers or streams are often covered under a discharge permit.

Industrial Reuse

Cooling towers

Cooling towers are recirculating evaporative cooling systems that can use reclaimed water to absorb process heat and then transfer the heat by evaporation. As the cooling water is recirculated, makeup water (reclaimed water) is required to replace water lost through evaporation. Water must also be periodically removed from the cooling tower system to prevent a buildup of dissolved solids in the cooling water. Cooling towers have become very efficient with only 1.5%–1.75% of the recirculated water being evaporated for every 10° F (6°C) drop in process water temperature, reducing the need to supplement the system flow with makeup water. Because water is evaporated, dissolved solids and minerals remain in the recirculated water, and these solids must be removed or treated to prevent accumulation in equipment. Removal of these solids is accomplished by discharging a portion of the cooling water, referred to as blow-down water. Blow-down water is usually

treated by a chemical process and/or a process that involves filtration, softening, or clarification before it is disposed of via a local wastewater treatment plant.

Any contamination of the cooling water through process in-leakage, atmospheric deposition, or treatment chemicals will also impact the water quality. While reclaimed water generally has very low concentrations of microorganisms due to a high level of treatment, one of the major issues is biological growth when nutrients are present in the reclaimed water. Biological growth can produce undesirable biofilm deposits. These deposits can interfere with heat transfer and cause microbiologically induced corrosion from acid or corrosive byproducts. Deposits also may shield metal surfaces from water treatment corrosion inhibitors and establish under-deposit corrosion. Biological films can grow rapidly and plug heat exchangers, create film on the cooling tower media, or plug cooling tower nozzles and sprays.

Scaling can also be a problem in cooling towers using reclaimed water. The primary constituents for scale potential from reclaimed water are calcium, magnesium, sulfate, alkalinity, phosphate, silica, and fluoride. Constituents with the potential to form scale must be evaluated and controlled by chemical treatment and/or by adjusting the cycles of concentration. Therefore, reclaimed water quality must be evaluated, along with the scaling potential, to establish effective use of specific scale inhibitors.

Boiler makeup water

The use of reclaimed water for boiler makeup water differs little from the use of conventional potable water – both require extensive pretreatment. High-pressure boilers require very high quality water; the primary concern is scale buildup and corrosion of equipment. Reclaimed water is not frequently used at military installations for boiler water and is only mentioned here for completeness.

Installation Reuse

As indicated under some other reuse categories above, water reuse is practiced on many Army installations. Examples include vehicle washing, irrigation, cooling tower makeup, and aquifer recharge. There is generally no controversy over the use of recycled water on Army installations. Where reclaimed water is available from nearby systems, installations have shown a

willingness to accept and use this highly treated water on site for irrigation and cooling tower makeup.

Currently, Army installations have a wide range of reuse. Water quality for the various reuses can also vary. For example, Fort Sam Houston, Texas, is connected to the San Antonio Water System's reuse pipeline and uses that highly treated reclaimed water for extensive irrigation and cooling tower makeup. Similarly, Fort Stewart, Georgia, has access to a regional wastewater treatment plant which supplies reclaimed water which Fort Stewart uses for irrigation. Major users of recycled water at many Army installations are the Central Vehicle Wash Facilities (CVWFs; Figure A-1). Large installations with a variety of tracked and wheeled vehicles can save over a million gallons per day by reusing their wash water following on-site treatment and save up to 200 million gallons per year. Fort Huachuca, Arizona, actively recharges highly treated effluent into infiltration basins which support local environmental needs and recharges local aquifers. The installation has also been installing French drains that capture roof runoff to infiltrate into the ground and recharge the local aquifer.

Figure A-1. A major user of recycled water are installation Central Vehicle Wash Facilities such as this one at Fort Carson, Colorado.

Potable Water Reuse

To date, the United States does not have any direct potable reuse projects. No state has developed regulations allowing such

use, although extensive discussions are ongoing within state professional associations and various health agencies. A few states have adopted criteria for indirect potable reuse of reclaimed water. California (which has the greatest number of existing indirect potable reuse projects in the United States) has draft groundwater-recharge regulations, whereas other states have adopted regulations for groundwater recharge or for both groundwater recharge and surface water augmentation. Criteria for indirect potable reuse include stringent treatment and quality criteria. Some other states rely on the USEPA's underground injection control (UIC) regulations to protect potable groundwater basins, while some states prohibit indirect potable reuse altogether. In some other states, regulations addressing indirect potable reuse are independent from the state's water reuse regulations. For example, the use of reclaimed water for groundwater recharge in Arizona is regulated under statutes and administrative rules administered by the Arizona Department of Environmental Quality and the Arizona Department of Water Resources. There are no federal regulations that specifically address reclaimed water reuse. Proposals to recharge groundwater by either surface spreading or injection in California are evaluated case-by-case, although currently existing draft groundwater recharge regulations guide decisions. Product water (the water produced during the specific wastewater reclamation treatment process train) to be recharged has to meet all primary drinking water standards and be monitored for other constituents of concern in addition to numerous other requirements. Florida has adopted similar reclaimed water treatment and quality requirements.

Planned indirect potable reuse has been practiced for decades in the form of surface spreading, direct injection, or addition upstream of a water treatment plant and has been taking place with increasing frequency. However, direct potable reuse is still controversial in many ways even as technology makes it possible. To date, no regulations or criteria have been developed or proposed. It has generally been deemed unacceptable by health regulators despite advances in treatment technology and monitoring, data from existing indirect projects, and data from the limited number of direct potable demonstrations and projects.

Issues for direct potable reuse include the following list.

- Definition of direct potable reuse
- Compensation for loss of an environmental buffer

- Multiple barriers
- Dilution
- Constituents of concern and monitoring
- Assessment of health risks
- but Applicability of regulations
- Regulatory responsibility
- Development of a communication system among agencies

The key difference between indirect and direct potable reuse is that there is no temporal or spatial separation between the introduction of the reclaimed or recycled water and its distribution as drinking water. The environmental buffer that precedes normal drinking water treatment is eliminated; the environmental buffer provides mixing, dilution, natural processes, and time for corrective action.

Other concerns applicable to direct potable reuse include regulatory requirements, health concerns, facility operation and management, and consumer perception. On the positive side, direct potable reuse can potentially address supply needs in water-scarce areas, provide greater flexibility for water use and reuse, and offer potential environmental benefits.

However, other countries have direct potable water reuse programs that are operating successfully. For example, Windhoek, Namibia, is the best-known and most-studied direct potable reuse system in the world, and it supplies a substantial portion of the local potable water supply. Water is treated through a complex and redundant treatment process train, with blending prior to distribution. Extensive monitoring takes place during and following treatment.

Before direct potable water reuse can take place in the United States, however, the complex subject of regulations must be addressed—numerous questions require answers. As stated before, regulations currently vary by state. Is potable water reuse treated as water supply, wastewater treatment, or both? Water rights issues are complex and vary state-by-state. Public health departments will be involved, along with other state agencies. Further complicating these potential regulations is the lack of concordance between state and federal rules and programs such as

the surface water treatment rule; drinking water source assessment programs; and the concept “use of extremely impaired sources.” Draft regulations exist for groundwater recharge into potable aquifers in some states, but what modifications may be needed? Is drinking water a beneficial use of recycled water? Will source water protection programs have to be established throughout a sewershed?

Most states have responsibility for regulating the CWA and SDWA, but these laws do not directly apply to potable reuse. As stated previously, no federal regulations for direct potable reuse exist. Regulatory responsibilities would include:

- approval of pollutant source control programs for wastewater collection systems;
- issuance and enforcement of reclaimed water requirements to producers and users of recycled water;
- regulation of operators of wastewater and water reclamation plants; and
- water rights determinations.

Due to the number of unanswered questions and the fact that states have primacy in the subject of direct potable reuse, it is recommended that the Army does not develop policy to direct potable reuse, but maintains an active awareness of the literature and committee work by various trade groups and lobbyists in individual bellwether states of California, Florida, Texas, and Arizona (being among the most active). The Army can accomplish this awareness through the Regional Energy and Environmental Centers.

State Regulatory Programs for Water Reuse

Several states have developed water reuse programs that build on examples from states with well-established programs such as Florida, California, Texas, and Arizona. Establishing an effective state water reuse program involves a number of complex factors beyond establishing guidelines or regulations. Elements of an effective state water reuse program are presented in Table A-5.

Table A-5. Key elements of a water reuse program (Table 4-1 from USEPA 2012, adapted from WateReuse Association 2009).

	Factor	Description
1	Establish the objectives	Objectives that encourage and promote reuse should be clear and concise.
2	Commit to the long run	A water reuse program should be considered a permanent, high-priority program within the state.
3	Identify the lead agency or agencies	The lead agencies should be able to issue permits for the production, distribution, and use of the reclaimed water. These permits are issued under state authority and are separate from the federal requirements for wastewater discharges to surface waters under the NPDES permit program. Preference to the lead agency determination should be given to the public health agency since the intent of the use of reclaimed water is for public contact and/or consumption following adequate and reliable treatment.
4	Identify water reuse leader	A knowledgeable and dedicated leader of the water reuse program who develops and maintains relationships with all water programs and other agencies should be designated.
5	Enact needed legislation	Initial legislation generally should be limited to a clear statement of the state objectives, a clear statement of authorization for the program, and other authorizations needed for implementation of specific program components. States also will want to review and evaluate existing state water law to determine what constraints, if any, it will impose on water reuse and what statutory refinements may be needed.
6	Adopt and implement rules or guidelines governing water reuse	With stakeholder involvement, a comprehensive and detailed set of reuse regulations or guidelines that are fully protective of environmental quality and public health should be developed and adopted in one location of the regulations. Formal regulations are not a necessity—they may be difficult and costly to develop and change and therefore overly rigid. Frameworks that have an ability to adapt to industry changes are most effective.
7	Be proactive	The water reuse program leader should be visible within the state and water reuse community while permitting staff of the lead agency must have a positive attitude in reviewing and permitting quality water reuse projects.
8	Develop and cultivate needed partnerships	Partnerships between the agency responsible for permitting the reclaimed water facilities (usually the lead agency) and the agency(ies) responsible for permitting water resources as well as the agency responsible for protection of public health are critical. Other agency partnerships, such as with potential major users of reclaimed water such as the department of transportation, are also helpful in fostering state-wide coordination and promotion of water reclamation.
9	Ensure the safety of water reuse	Ensuring the protection of public health and safety can be accomplished by placing reliance on production of high-quality reclaimed water with minimal end use controls, or allowing lower levels of treatment with additional controls on the use of reclaimed water (setback distances, time of day restrictions, limits on types of use, etc.), or by a combination of both types of regulations. A formal reliability assessment to assure a minimum level or redundancy and reliability to review and detail operating standards, maintainability, critical operating conditions, spare parts requirements and availability, and other issues that affect the ability of the plant to continuously produce reclaimed water. A critical component to ensuring the safety of reclaimed water for public access and contact-type reuse is defining requirements for achieving a high level of disinfection and the monitoring program necessary to ensure compliance (this is described further in Chapter 6).
10	Develop specific program components	Program components are going to differ from state to state and maturity of the reuse program.
11	Focus on quality, integrity, and service	Not only should the reclaimed water utilities implement high-quality reuse systems that are operated effectively, but the lead agency should also model this commitment to quality and prompt service to the regulated and general public regarding reuse inquiries and permitting issues. In effect, the lead agency should focus on building same level of trust public potable water systems develop and re-establish daily.
12	Be consistent	A comprehensive and detailed set of state regulations, as well as having a lead reuse role, help keep the permitting of reuse systems consistent. If there are multiple branches around the state involved in permitting, training and other measures of retaining consistency must be taken.
13	Promote a water reuse community	The lead agency should be proactive in developing and maintaining the state's water reuse community—reuse utilities, consulting engineers, state agencies, water managers, health departments, universities, researchers, users of reclaimed water, and others—in an effort to disseminate information and obtain feedback related to possible impediments, issues, and future needs. Active participation in the national and local reuse organizations is valuable.

	Factor	Description
14	Maintain a reuse inventory	Maintenance of a periodical (e.g., annual) reuse inventory is essential in tracking success of a state's water reuse program. Facilities in Florida that provide reclaimed water are required by their permits to submit an annual reuse report form every year. That data not only is used in the states annual reuse inventory report and reuse statistics but is also shared with the WateReuse Association's National Reuse Database.
15	Address cross-connection control issues	Coordination and joint activity between agencies and within agencies (drinking water program, wastewater program, water reuse program, etc.) must be taken to address cross-connection control issues (this is described further in Chapter 2).

In the early stages, reuse programs must address the framework of regulations under which they will operate. Thus, a thorough understanding of all applicable regulations is required to plan the most effective design and operation of a water reuse program and to streamline its implementation. Currently, there are no federal regulations directly governing water reuse practices in the United States; therefore, each state may choose to adopt rules and develop programs for water reuse to meet specific resource needs and to ensure that projects are designed, constructed, and operated to be protective of public health, the environment and other beneficial uses. To accomplish this, water reuse regulations and guidelines have been developed by many states. Regulations refer to actual rules that have been enacted and are enforceable by government agencies. Guidelines, on the other hand, are generally not enforceable, but can be used in the development of a reuse program. In some states, however, guidelines are, by reference, included in the regulations and therefore are enforceable. In addition to providing treatment and water quality requirements, comprehensive rules or guideline also promote reuse by providing the playing field for which projects must comply. Table A-6 provides fundamental components of a regulatory framework that states could draw from when developing or amending rules or regulations for water reuse.

Table A-6. Fundamental components of a water reuse regulatory framework for states (Table 4-2 USEPA 2012).

Category	Comment
Purpose and/or goal statement	♣ Frame the state's purpose for developing the rule or regulation (e.g., to satisfy a need or fulfill a statutory requirement), and describe the ultimate vision for the water reuse program. The process to authorize, develop, and implement rules or *changes* to rules is time consuming and costly. After adoption, rules are difficult to change, which limits the ability to accommodate new technologies and information.
Definitions	♣ Define type of use and other water reuse-related terms used within the body of the rule or regulation.
Scope, and Applicability	♣ Define the scope and applicability of the rules or regulations that delineates what facilities, systems, and activities are subject to the requirements of the rules or regulations. ♣ Include grandfathering or transitioning provisions for existing facilities, systems, or activities not regulated prior to the adoption of the rules or regulations.
Exclusions and prohibitions	♣ Describe facilities, systems and activities that are 1) not subject to the requirements of the rules or regulations, and 2) specifically prohibited by the rules or regulations.

Category	Comment
Variances	♣ Describe procedures for variances to design, construction, operation, and/or maintenance requirements of the regulation for hardships that outweigh the benefit of a project, and the variance, if granted, would not adversely impact human health, other beneficial uses, or the environment. These variance procedures give regulators flexibility to consider projects that may deviate only minimally from the requirements with no significant adverse impact or opportunities that are not anticipated during initial development of a regulation. Since variances need to be based on sound, justifiable reasons for change, regulatory programs should develop guidance on how to develop adequate justification that can be relied upon as precedence setting for future regulatory decisions and actions.
Permitting requirements	♣ Describe the permitting framework for water reuse. Indicate whether the water reuse rule or regulation will serve as the permitting mechanism for water reuse projects or identify other regulations through which the water reuse rule or regulation will be implemented and projects permitted. ♣ Describe if or how end users of reclaimed water will be permitted, and rights of end user to refuse reclaimed water if not demanded. ♣ Describe permit application requirements and procedures. Specify all information that the applicant must provide in order to appropriately evaluate and permit the water reuse projects.
Define or refine control and access to reclaimed water	♣ Determine the rights to and limits of access and control over reclaimed water for subsequent use and the relationship between the underlying water right, wastewater collection system ownership, reclamation plant ownership, and downstream water users who have demonstrated good-faith reliance on the return of the wastewater effluent into a receiving stream within the limits and requirements of the state's water rights statutory and regulatory requirements.
Relationship to other rules	♣ Describe relationship between water reuse rule or regulation and, for example, water and wastewater regulations, environmental flow requirements, solid waste or hazardous waste rules, groundwater protection, required water management plans, and relevant health and safety codes for housing, plumbing, and building.
Relationship to stakeholders	♣ Identify regulatory or non-regulatory stakeholders from various sectors (e.g., water, wastewater, housing, planning, irrigation, parks, ecology, public health, etc.) that have a role or duty in the statewide reuse program.
Relationship to regulations or guidelines for uses of other non-conventional water sources	♣ Describe other rules or regulations that exist for graywater recycle and stormwater or rainwater harvesting and use. ♣ Some states may choose to develop a more comprehensive approach that encompasses rules or regulations for all non-conventional water sources, including water reuse, within one set of rules or regulations.
Reclaimed water standards	♣ See Tables 4-6 to 4-15 for standards that are either defined by end use or by degree of human contact. ♣ Include a provision to evaluate and allow standards to be developed on a case-by-case basis for less common uses of reclaimed water that are not listed. ♣ Require points of compliance to be established to verify compliance with standards. ♣ Describe response and corrective action for occurrence of substandard reclaimed water (a component of the Contingency Plan, below).
Treatment technology requirements	♣ In addition to reclaimed water standards, some states specify treatment technologies for specific reuse applications.
Monitoring requirements	♣ Describe methods and frequency for monitoring all standards listed in the rules or regulations.
Criteria or standards for design, siting and construction	♣ Describe criteria or standards of engineering design, siting, and construction for water reuse facilities and systems that typically include, but are not limited to, facilities or systems to treat/reclaim, distribute, and store water for reuse. ♣ Develop requirements for dual plumbed distributions systems (separate distribution of potable and nonpotable water) that are co-located. ♣ Describe requirements for the transfer of reclaimed water and its alternative disposal if unsuitable or not required by target user (e.g., during wet seasons).
Construction requirements	♣ Describe requirements for engineering reports, pilot studies, and certificates required to construct and to operate.
Operations and maintenance (O&M)	♣ Describe minimum requirements for the submission and content of O&M manual. The scope and content of an O&M manual will be determined by the type and complexity of the system(s) described by the manual.

Category	Comment
Management of pollutants from significant industrial users as source water protection	♣ Where facilities or systems with inputs from significant industrial users are proposing to generate reclaimed water suitable for human contact or potable reuse, describe programs that must be implemented to manage pollutant of concern from significant industrial users. ♣ Pretreatment programs of combined publicly owned treatment works and reclamation systems may satisfy program requirements. ♣ Develop program requirements for satellite reclamation systems also affected by inputs from significant industrial users. ♣ Such pretreatment programs should develop discharge limits that are intended to protect source water, rather than wastewater treatment and sewer system integrity.
Access control and use area requirements	♣ Describe requirements to control access to sites where reclaimed water will be generated, or in some cases, stored or utilized. ♣ Describe requirements for advisory sign placement, message, and size. ♣ Describe requirements for proper use of reclaimed water by end users to ensure protection of the environment and human health (.e.g., setbacks, physical barriers or practices to prevent reclaimed water from leaving the site of use, etc.).
Education and notification	♣ Include requirements for generators or providers of reclaimed water to educate end users of appropriate handling and use of the water, and to provide notification to end users regarding the discharges of substandard water to reuse and loss of service for planned or unplanned cause.
Operational flow requirements	♣ Requirements for maintaining flow within design capacity of treatment system or planning for additional treatment capacity as needed.
Contingency plan	♣ Include a requirement for a contingency plan that describes how system failures, unauthorized discharges, or upsets will be remedied or addressed.
Recordkeeping	♣ Describe what operating records must be maintained, the location where they are retained, and the minimum period of retention.
Reporting	♣ Describe what items must be reported, the frequency of reporting, and to whom they are reported.
Stakeholder participation	♣ Requirements on public notice, involvement, and decision-making. This will apply where the water reuse rule or regulation is used as the vehicle to permit water reuse projects.
Financial assistance	♣ Describe state, local, or federal funding or financing sources.

States' regulatory programs for water reuse must be consistent with and, in some cases, function within the limitations imposed by other state and federal laws, regulations, rules, and policies. Laws, policies, rules, and regulations that affect water reuse project planning include water rights laws, water use, and wastewater discharge regulations, as well as laws that restrict land use and protect the environment.

Water Rights

Water reuse regulatory programs must work within the prevailing water rights laws of each state. At statehood, each state in the United States was granted ownership and control over all waters within their boundaries. These water rights provide the legal right for an entity to divert, capture, and use water within the boundaries of an individual state.

In the United States, there are two main approaches to water rights law: appropriative doctrines (common in historically water-scarce areas) and riparian doctrines (common in historically water-abundant areas). In the first approach, appropriative water rights are assigned or delegated to

consumers, generally based on seniority of which users laid first claim to that water and not from the property's proximity to the water source. In contrast, riparian water rights are based on the proximity to water and are acquired by purchasing the land. In the West, reuse can be the target of legal challenges, depending on how the local system of water rights regards the use and return of reclaimed water.

Access to or control over reclaimed water, like formal water rights, is unique to each individual state. While most owners of water reclamation facilities generally have first rights to the use of the reclaimed water, there are scenarios where the facility is obligated to discharge effluents to receiving water bodies rather than using the reclaimed water for other beneficial uses.

The most significant constraint affecting use of reclaimed water is the need to assure minimum in-stream flows sufficient to protect aquatic habitat, especially to protect habitat of threatened and endangered fish or other species. There are also cases where federal water laws may affect or supersede state regulatory programs for water reuse, particularly where water reuse would impact international boundaries, Native American water rights, multiple states with a claim on limited water supplies, water rights on federal property (or on non-reserved lands), in-stream flow requirements to support threatened and endangered fisheries under the Endangered Species Act (ESA), and other federal reserved water rights.

Water Supply and Use Regulations

Federal, state, and local entities may set standards for how water may be used as a condition for supply, and these standards can include water use restrictions, water efficiency goals, or water supply reductions. Some of these standards include criteria for substitution and offset credits associated with use of reclaimed water and the resulting benefit to the utility provider. Water use restrictions may serve to promote reuse when water users are required to use potable or reclaimed water for only certain uses under specific conditions. Mandatory or voluntary water efficiency goals may be issued as part of a holistic water management program by individual states. Water reuse may qualify or be required as water efficiency measures. Water supply reductions are most often imposed during periods of drought and can trigger seniority-based water allocations.

Wastewater Regulations

Both the federal government and state agencies have jurisdiction over the quantity and quality of wastewater discharge into public waterways of the United States. Primary authority is with the CWA which assigned the federal government and states specific responsibilities for water quality management. Major objectives of the CWA are to eliminate all pollutant discharges into navigable waters, stop discharges of toxic pollutants in toxic amounts, develop wastewater treatment management plans to control sources of pollutants, and to encourage (but not require) water reclamation and reuse. Primary jurisdiction under the CWA is with the EPA, but in most states many provisions are administered and enforced by state water pollution control agencies.

Drinking Water Source Protection

Where reclaimed water may impact drinking water sources, the SDWA comes into play. The SDWA is the primary federal law that ensures quality of drinking water. Under the SDWA, EPA sets national health-based standards or maximum contaminant levels (MCLs), for drinking water quality and oversees the states, localities, and water suppliers that implement those standards. Amendments to the law set requirements for source water protection requiring each state to conduct an assessment of its sources of drinking water to identify significant potential sources of water quality contamination. State water reuse programs must be compatible and consistent with these requirements.

Land Use

Several western states have adopted laws that require new developments to adopt sustainable water management plans, which may encourage water reuse. In chronically water-short or environmentally-sensitive areas, use of reclaimed water may be a prerequisite for new developments.

Suggested Regulatory Guidelines for Water Reuse Categories

The updated EPA Guidelines present the most common reuses regulated by states into categories listed in Table A-7 and minimum recommended guidelines Table A-8. This is a general synthesis and it is important to note that definition of each category of reuse and allowable uses included with individual states may vary from these definitions, i.e. they may not exactly match individual states. The information presented

serves as a means for general reuse types and can be used to compare existing state regulations.

Table A-7. Water reuse categories and number of states with rules, regulations or guidelines addressing these reuse categories[1] (Table 4-3 in USEPA 2012).

Category of reuse		Description	Number of States
Urban Reuse	**Unrestricted**	The use of reclaimed water for nonpotable applications in municipal settings where public access is not restricted.	32
	Restricted	The use of reclaimed water for nonpotable applications in municipal settings where public access is controlled or restricted by physical or institutional barriers, such as fencing, advisory signage, or temporal access restriction.	40
Agricultural Reuse	**Food Crops**	The use of reclaimed water to irrigate food crops that are intended for human consumption.	27
	Processed Food Crops and Non-food Crops	The use of reclaimed water to irrigate crops that are either processed before human consumption or not consumed by humans.	43
Impoundments	**Unrestricted**	The use of reclaimed water in an impoundment in which no limitations are imposed on body-contact water recreation activities (some states categorize snowmaking in this category).	13
	Restricted	The use of reclaimed water in an impoundment where body contact is restricted (some states include fishing and boating in this category).	17
Environmental Reuse		The use of reclaimed water to create, enhance, sustain, or augment water bodies, including wetlands, aquatic habitats, or stream flow.	17
Industrial Reuse		The use of reclaimed water in industrial applications and facilities, power production, and extraction of fossil fuels	31
Groundwater Recharge – Nonpotable Reuse		The use of reclaimed water to recharge aquifers that are not used as a potable water source.	16
Potable Reuse	**Indirect Potable Reuse (IPR)**	Augmentation of a drinking water source (surface or groundwater) with reclaimed water followed by an environmental buffer that precedes normal drinking water treatment.	9
	Direct Potable Reuse (DPR)	The introduction of reclaimed water (with or without retention in an engineered storage buffer) directly into a water treatment plant, either collocated or remote from the advanced wastewater treatment system.	0

[1] Individual state reuse programs often incorporate different terminology so the reader should exercise caution in comparing the categories in these tables directly to state regulatory definitions.

Table A-8 presents suggested treatment processes, reclaimed water quality, monitoring frequency, and setback distances for various types of water reuse. The assumption is made that the wastewater treatment plant producing these waters are primarily domestic sewage and minimal amounts of industrial waste and are for US facilities. The suggestions are based on water reuse experience in the US and elsewhere; research and pilot plant or demonstration study data; technical material from the literature; various states' regulations, policies, or guidelines; attainability and sound engineering practice and are not intended to be definitive (USEPA 2012). Additional detail and explanation is available in that document.

Table A-8. Suggested guidelines for water reuse(1) (Table 4-4 in USEPA 2012).

Reuse Category and Description	Treatment	Reclaimed Water Quality (2)	Reclaimed Water Monitoring	Setback Distances (3)	Comments
Urban Reuse					
Unrestricted The use of reclaimed water in nonpotable applications in municipal settings where public access is not restricted.	♣ Secondary(4) ♣ Filtration(5) ♣ Disinfection(6)	♣ pH = 6.0-9.0 ♣ ≤ 10 mg/l BOD (7) ♣ ≤ 2 NTU (8) ♣ No detectable fecal coliform /100 ml (9,10) ♣ 1 mg/l Cl_2 residual (min.) (11)	♣ pH – weekly ♣ BOD – weekly ♣ Turbidity – continuous ♣ Fecal coliform – daily ♣ Cl_2 residual – continuous	♣ 50 ft (15 m) to potable water supply wells; increased to 100 ft (30 m) when located in porous media (18)	♣ At controlled-access irrigation sites where design and operational measures significantly reduce the potential of public contact with reclaimed water, a lower level of treatment, e.g., secondary treatment and disinfection to achieve < 14 fecal coli/100 ml may be appropriate. ♣ Chemical (coagulant and/or polymer) addition prior to filtration may be necessary to meet water quality recommendations. ♣ The reclaimed water should not contain measurable levels of pathogens. (12) ♣ Reclaimed water should be clear and odorless. ♣ Higher chlorine residual and/or a longer contact time may be necessary to assure that viruses and parasites are inactivated or destroyed. ♣ Chlorine residual > 0.5 mg/l in the distribution system is recommended to reduce odors, slime, and bacterial regrowth.
Restricted The use of reclaimed water in nonpotable applications in municipal settings where public access is controlled or restricted by physical or institutional barriers, such as fencing, advisory signage, or temporal access restriction.	♣ Secondary (4) ♣ Disinfection (6) ♣	♣ pH = 6.0-9.0 ♣ ≤ 30 mg/l BOD (7) ♣ ≤ 30 mg/l TSS ♣ ≤ 200 fecal coliform /100 ml (9, 13, 14) ♣ 1 mg/l Cl_2 residual (min.) (11)	♣ pH – weekly ♣ BOD – weekly ♣ TSS – daily ♣ Fecal coliform – daily ♣ Cl_2 residual – continuous	♣ 300 ft (90 m) to potable water supply wells ♣ 100 ft (30 m) to areas accessible to the public (if spray irrigation)	♣ If spray irrigation, TSS less than 30 mg/l may be necessary to avoid clogging of sprinkler heads. ♣ See Section 3.4.3 in the 2004 guidelines for recommended treatment reliability requirements. ♣ For use in construction activities including soil compaction, dust control, washing aggregate, making concrete, worker contact with reclaimed water should be minimized and a higher level of disinfection (e.g. < 14 fecal coli/100 ml) should be provided when frequent worker contact with reclaimed water is likely.

Reuse Category and Description	Treatment	Reclaimed Water Quality [2]	Reclaimed Water Monitoring	Setback Distances [3]	Comments
Agricultural Reuse					
Food Crops [15] The use of reclaimed water for surface or spray irrigation of food crops which are intended for human consumption, consumed raw.	♣ Secondary [4] ♣ Filtration [5] ♣ Disinfection [6]	♣ pH = 6.0-9.0 ♣ ≤ 10 mg/l BOD [7] ♣ ≤ 2 NTU [8] ♣ No detectable fecal coliform/100 ml [9,10] ♣ 1 mg/l Cl_2 residual (min.) [11]	♣ pH – weekly ♣ BOD – weekly ♣ Turbidity – continuous ♣ Fecal coliform – daily ♣ Cl_2 residual – continuous	♣ 50 ft (15 m) to potable water supply wells; increased to 100 ft (30 m) when located in porous media [18]	♣ See Table 3-5 for other recommended chemical constituent limits for irrigation. ♣ Chemical (coagulant and/or polymer) addition prior to filtration may be necessary to meet water quality recommendations. ♣ The reclaimed water should not contain measurable levels of pathogens. [12] ♣ Higher chlorine residual and/or a longer contact time may be necessary to assure that viruses and parasites are inactivated or destroyed. ♣ High nutrient levels may adversely affect some crops during certain growth stages. ♣ See Section 3.4.3 in the 2004 guidelines for recommended treatment reliability requirements.
Processed Food Crops [15] The use of reclaimed water for surface irrigation of food crops which are intended for human consumption, commercially processed. *Non-Food Crops* The use of reclaimed water for irrigation of crops which are not consumed by humans, including fodder, fiber, and seed crops, or to irrigate pasture land, commercial nurseries, and sod farms.	♣ Secondary [4] ♣ Disinfection [6]	♣ pH = 6.0-9.0 ♣ ≤ 30 mg/l BOD [7] ♣ ≤ 30 mg/l TSS ♣ ≤ 200 fecal coli/100 ml [9,13, 14] ♣ 1 mg/l Cl_2 residual (min.) [11]	♣ pH – weekly ♣ BOD – weekly ♣ TSS – daily ♣ Fecal coliform – daily ♣ Cl_2 residual – continuous	♣ 300 ft (90 m) to potable water supply wells ♣ 100 ft (30 m) to areas accessible to the public (if spray irrigation)	♣ See Table 3-5 for other recommended chemical constituent limits for irrigation. ♣ If spray irrigation, TSS less than 30 mg/l may be necessary to avoid clogging of sprinkler heads. ♣ High nutrient levels may adversely affect some crops during certain growth stages. ♣ See Section 3.4.3 in the 2004 guidelines for recommended treatment reliability requirements. ♣ Milking animals should be prohibited from grazing for 15 days after irrigation ceases. A higher level of disinfection,

Reuse Category and Description	Treatment	Reclaimed Water Quality [2]	Reclaimed Water Monitoring	Setback Distances [3]	Comments
Impoundments					
Unrestricted The use of reclaimed water in an impoundment in which no limitations are imposed on body-contact.	♣ Secondary [4] ♣ Filtration [5] ♣ Disinfection [6]	♣ pH = 6.0-9.0 [7] [8] ♣ No detectable fecal coliform/100 mi [9,10] ♣ 1 mg/l Cl_2 residual (min.) [11]	♣ pH – weekly ♣ BOD – weekly ♣ Turbidity – continuous ♣ Fecal coliform – daily ♣ Cl_2 residual – continuous	♣ 500 ft (150 m) to potable water supply wells (min.) if bottom not sealed	♣ Dechlorination may be necessary to protect aquatic species of flora and fauna. ♣ Reclaimed water should be non-irritating to skin and eyes. ♣ Reclaimed water should be clear and odorless. ♣ Nutrient removal may be necessary to avoid algae growth in impoundments. ♣ Chemical (coagulant and/or polymer) addition prior to filtration may be necessary to meet water qualityrecommendations. ♣ Reclaimed water should not contain measurable levels of pathogens. [12] ♣ Higher chlorine residual and/or a longer contact time may be necessary to assure that viruses and parasites are inactivated or destroyed. ♣ Fish caught in impoundments can be consumed. ♣ See Section 3.4.3 in the 2004 guidelines for recommended treatment reliability requirements.
Restricted The use of reclaimed water in an impoundment where body-contact is restricted.	♣ Secondary [4] ♣ Disinfection [6]	♣ ≤ 30 mg/l BOD [7] ♣ ≤ 30 mg/l TSS ♣ ≤ 200 fecal coliform/100 ml [9,13, 14] ♣ 1 mg/l Cl_2 residual (min.) [11]	♣ pH – weekly ♣ TSS – daily ♣ Fecal coliform – daily ♣ Cl_2 residual – continuous	♣ 500 ft (150 m) to potable water supply wells (min.) if bottom not sealed	♣ Nutrient removal may be necessary to avoid algae growth in impoundments. ♣ Dechlorination may be necessary to protect aquatic species of flora and fauna. ♣ See Section 3.4.3 in the 2004 guidelines for recommended treatment reliability requirements.

Reuse Category and Description	Treatment	Reclaimed Water Quality [2]	Reclaimed Water Monitoring	Setback Distances [3]	Comments
Environmental Reuse					
The use of reclaimed water to create wetlands, enhance natural wetlands, or sustain streamflows.	♣ Variable ♣ Secondary [4] and disinfection [6] (min.)	Variable, but not to exceed: ♣ ≤30 mg/l BOD [7] ♣ ≤ 30 mg/l TSS ♣ ≤ 200 fecal coliform/100 ml [9,13, 14] ♣ 1 mg/l Cl_2 residual (min.)	♣ BOD – weekly ♣ SS – daily ♣ Fecal coliform – daily ♣ Cl_2 residual – continuous		♣ Dechlorination may be necessary to protect aquatic species of flora and fauna. ♣ Possible effects on groundwater should be evaluated. ♣ Receiving water quality requirements may necessitate additional treatment. ♣ Temperature of the reclaimed water should not adversely affect ecosystem. ♣ See Section 3.4.3 in the 2004 guidelines for recommended treatment reliability requirements.
Industrial Reuse					
Once-through Cooling	♣ Secondary [4]	♣ pH = 6.0-9.0 ♣ ≤ 30 mg/l BOD [7] ♣ ≤ 30 mg/l TSS ♣ ≤ 200 fecal coliform/100 ml [9,13, 14] ♣ 1 mg/l Cl_2 residual (min.) [11]	♣ pH – weekly ♣ BOD – weekly ♣ TSS – weekly ♣ Fecal coliform – daily ♣ Cl_2 residual – continuous	♣ 300 ft (90 m) to areas accessible to the public	♣ Windblown spray should not reach areas accessible to workers or the public.

Reuse Category and Description	Treatment	Reclaimed Water Quality [2]	Reclaimed Water Monitoring	Setback Distances [3]	Comments
Recirculating Cooling Towers	♣ Secondary [4] ♣ Disinfection [6] (chemical coagulation and filtration [5] may be needed)	Variable, depends on recirculation ratio: ♣ pH = 6.0-9.0 ♣ ≤ 30 mg/l BOD [7] ♣ ≤ 30 mg/l TSS ♣ ≤ 200 fecal coliform/100 ml [9,13, 14] ♣ 1 mg/l Cl_2 residual (min.) [11]		♣ 300 ft (90 m) to areas accessible to the public. May be reduced if high level of disinfection is provided.	♣ Windblown spray should not reach areas accessible to workers or the public. ♣ Additional treatment by user is usually provided to prevent scaling, corrosion, biological growths, fouling and foaming. ♣ See Section 3.4.3 in the 2004 guidelines for recommended treatment reliability requirements.
Other Industrial uses – e.g. boiler feed, equipment washdown, processing, power generation, and in the oil and natural gas production market (including hydraulic fracturing) have requirements that depends on site specific end use (See Chapter 3)					
Groundwater Recharge – Nonpotable Reuse					
The use of reclaimed water to recharge aquifers which are not used as a potable drinking water source.	♣ Site specific and use dependent ♣ Primary (min.) for spreading ♣ Secondary [4] (min.) for injection	♣ Site specific and use dependent	♣ Depends on treatment and use	♣ Site specific	♣ Facility should be designed to ensure that no reclaimed water reaches potable water supply aquifers. ♣ See Chapter 3 of this document and Section 2.5 of the 2004 guidelines for more information. ♣ For injection projects, filtration, and disinfection may be needed to prevent clogging. ♣ For spreading projects, secondary treatment may be needed to prevent clogging. ♣ See Section 3.4.3 in the 2004 guidelines for recommended treatment reliability requirements.

Reuse Category and Description	Treatment	Reclaimed Water Quality [2]	Reclaimed Water Monitoring	Setback Distances [3]	Comments
Indirect Potable Reuse					
Groundwater Recharge by Spreading into Potable Aquifers	♣ Secondary [4] ♣ Filtration [5] ♣ Disinfection [6] ♣ Soil aquifer treatment	Includes, but not limited to, the following: ♣ No detectable total coliform/100 ml [9, 10, 11] ♣ pH = 6.5 – 8.5 ♣ ≤ 2 NTU [8] ♣ ≤ 2 mg/l TOC of wastewater origin ♣ Meet drinking water standards after percolation through vadose zone	Includes, but not limited to, the following: ♣ pH – daily ♣ Total coliform – daily ♣ Cl_2 residual – continuous ♣ Drinking water standards – quarterly ♣ Other [17] – depends on constituent ♣ TOC – weekly ♣ Turbidity – continuous ♣ Monitoring is not required for viruses and parasites: their removal rates are prescribed by treatment requirements	♣ Distance to nearest potable water extraction well that provides a minimum of 2 months retention time in the underground.	♣ Depth to groundwater (i.e., thickness to the vadose zone) should be at least 6 feet (2m) at the maximum groundwater mounding point. ♣ The reclaimed water should be retained underground for at least 2 months prior to withdrawal. ♣ Recommended treatment is site-specific and depends on factors such as type of soil, percolation rate, thickness of vadose zone, native groundwater quality, and dilution. ♣ Monitoring wells are necessary to detect the influence of the recharge operation on the groundwater. ♣ Reclaimed water should not contain measurable levels of pathogens after percolation through the vadose zone.[12] ♣ See Section 3.4.3 in the 2004 Guidelines for recommended treatment reliability requirements. ♣ Recommended log-reductions of viruses, *Giardia*, and *Cryptosporidium* can be based on challenge tests or the sum of log-removal credits allowed for individual treatment processes. Monitoring for these pathogens is not required.

Reuse Category and Description	Treatment	Reclaimed Water Quality [2]	Reclaimed Water Monitoring	Setback Distances[3]	Comments
Groundwater Recharge by Injection into Potable Aquifers	♣ Secondary (4) ♣ Filtration (5) ♣ Disinfection (6) ♣ Advanced wastewater treatment (16)	Includes, but not limited to, the following: ♣ No detectable total coliform/100 ml (9, 10) (11) ♣ pH = 6.5 – 8.5 ♣ ≤ 2 NTU (8) ♣ ≤ 2 mg/l TOC of wastewater origin ♣ Meet drinking water standards	Includes, but not limited to, the following: ♣ pH – daily ♣ Turbidity – continuous ♣ Total coliform – daily ♣ Cl_2 residual – continuous ♣ TOC – weekly ♣ Drinking water standards – quarterly ♣ Other (17) – depends on constituent ♣ Monitoring is not required for viruses and parasites: their removal rates are prescribed by treatment requirements	♣ Distance to nearest potable water extraction well that provides a minimum of 2 months retention time in the underground.	♣ The reclaimed water should be retained underground for at least 2 months prior to withdrawal. ♣ Monitoring wells are necessary to detect the influence of the recharge operation on the groundwater. ♣ Recommended quality limits should be met at the point of injection. ♣ The reclaimed water should not contain measurable levels of pathogens at the point of injection. ♣ Higher chlorine residual and/or a longer contact time may be necessary to assure virus inactivation. ♣ See Section 3.4.3 in the 2004 Guidelines for recommended treatment reliability requirements. ♣ Recommended log-reductions of viruses, Giardia, and Cryptosporidium can be based on challenge tests or the sum of log-removal credits allowed for individual treatment processes. Monitoring for these pathogens is not required. ♣ Dilution of reclaimed water with waters of non-wastewater origin can be used to help meet the suggested TOC limit.
Augmentation of Surface Water Supply Reservoirs	♣ Secondary (4) ♣ Filtration (5) ♣ Disinfection (6) ♣ Advanced wastewater treatment (16)	Includes, but not limited to, the following: ♣ No detectable total coliform/100 ml (9, 10) ♣ 1 mg/l Cl_2 residual (min.) (11) ♣ pH = 6.5 – 8.5 ♣ ≤ 2 NTU (8) ♣ ≤ 2 mg/l TOC of wastewater origin ♣ Meet drinking water standards		♣ Site specific – based on providing 2 months retention time between introduction of reclaimed water into a raw water supply reservoir and the intake to a potable water treatment plant.	♣ The reclaimed water should not contain measurable levels of pathogens. (12) ♣ Recommended level of treatment is site-specific and depends on factor such as receiving water quality, time and distance to point of withdrawal, dilution and subsequent treatment prior to distribution for potable uses. ♣ Higher chlorine residual and/or a longer contact time may be necessary to assure virus and protozoa inactivation. ♣ See Section 3.4.3 in the 2004 Guidelines for recommended treatment reliability requirements. ♣ Recommended log-reductions of viruses, *Giardia*, and *Cryptosporidium* can be based on challenge tests or the sum of log-removal credits allowed for individual treatment processes. Monitoring for these pathogens is not required. ♣ Dilution of reclaimed water with water of non-wastewater origin can be used to help meet the suggested TOC limit.

Footnotes

(1) These guidelines are based on water reclamation and reuse practices in the US, and are specifically directed at states that have not developed their own regulations or guidelines. While the guidelines should be useful in many areas outside the US, local conditions may limit the applicability of the guidelines in some countries (see Chapter 9). It is explicitly stated that the direct application of these suggested guidelines will not be used by USAID as strict criteria for funding.

(2) Unless otherwise noted, recommended quality limits apply to the reclaimed water at the point of discharge from the treatment facility.

(3) Setback distances are recommended to protect potable water supply sources from contamination and to protect humans from unreasonable health risks due to exposure to reclaimed water.

(4) Secondary treatment process include activated sludge processes, trickling filters, rotating biological contractors, and may stabilization pond systems. Secondary treatment should produce effluent in which both the BOD and SS do not exceed 30 mg/l.

(5) Filtration means; the passing of wastewater through natural undisturbed soils or filter media such as sand and/or anthracite; or the passing of wastewater through microfilters or other membrane processes.

(6) Disinfection means the destruction, inactivation, or removal of pathogenic microorganisms by chemical, physical, or biological means. Disinfection may be accomplished by chlorination, ozonation, other chemical disinfectants, UV, membrane processes, or other processes.

(7) As determined from the 5-day BOD test.

(8) The recommended turbidity should be met prior to disinfection. The average turbidity should be based on a 24-hour time period. The turbidity should not exceed 5 NTU at any time. If SS is used in lieu of turbidity, the average SS should not exceed 5 mg/l. If membranes are used as the filtration process, the turbidity should not exceed 0.2 NTU and the average SS should not exceed 0.5 mg/l.

(9) Unless otherwise noted, recommended coliform limits are median values determined from the bacteriological results of the last 7 days for which analyses have been completed. Either the membrane filter or fermentation tube technique may be used.

(10) The number of total or fecal coliform organisms (whichever one is recommended for monitoring in the table) should not exceed 14/100 ml in any sample.

(11) This recommendation applies only when chlorine is used as the primary disinfectant. The total chlorine residual should be met after a minimum actual modal contact time of at least 90 minutes unless a lesser contact time has been demonstrated to provide indicator organism and pathogen reduction equivalent to those suggested in these guidelines. In no case should the actual contact time be less than 30 minutes.

(12) It is advisable to fully characterize the microbiological quality of the reclaimed water prior to implementation of a reuse program.

(13) The number of fecal coliform organisms should not exceed 800/100 ml in any sample.

(14) Some stabilization pond systems may be able to meet this coliform limit without disinfection.

(15) Commercially processed food crops are those that, prior to sale to the public or others, have undergone chemical or physical processing sufficient to destroy pathogens.

(16) Advanced wastewater treatment processes include chemical clarification, carbon adsorption, reverse osmosis and other membrane processes, advanced oxidation, air stripping, ultrafiltration, and ion exchange.

(17) Monitoring should include inorganic and organic compounds, or classes of compounds, that are known or suspected to be toxic, carcinogenic, teratogenic, or mutagenic and are not included in the drinking water standards.

(18) See Section 4.4.3.7 for additional precautions that can be taken when a setback distance of 100 ft (30 m) to potable water supply wells in porous media is not feasible.

The combination of both treatment process requirements and water quality limits were recommended for the following reasons (USEPA 2012):

- Water quality criteria that include the use of surrogate parameters may not adequately characterize reclaimed water quality.
- A combination of treatment and quality requirements known to produce reclaimed water of acceptable quality obviate the need to routinely monitor the finished water for certain constituents, e.g. some health-significant chemical constituents or pathogenic microorganisms.
- Monitoring of real-time surrogates of key treatment processes for their performance now allows assurances of removal of pathogens
- Treatment reliability is enhanced.

Summary of State Regulations

The USEPA Guidelines document (2012) presents results from a survey of individual states, tribal communities, and territories. Regulatory agencies were contacted to obtain information concerning their current regulations or guidelines governing water reuse. Table A-9 provides a summary of the current regulations and guidelines governing water reuse by state and by reuse category. The table identifies those states that have regulations, those with guidelines and those which do not currently have either. The table also distinguishes between those regulations or guidelines which have a primary intent of oversight of water reuse versus those that are intended to facilitate disposal, with reuse being incidental. The distinction between those two purposes can be quite subjective and open to interpretation, but are presented to capture some of the nuance in interpreting a state’s intent.

As of August 2012, 22 states have adopted regulations and 11 states have guidelines or design standards with water reuse as the primary intent. Also, 8 states and the Commonwealth of the Northern Mariana Islands (CNMI) have regulations, and 4 states have guidelines which impact water reuse primarily from a disposal perspective. To date, no states have regulations or guidelines specifically governing direct potable water reuse (USEPA 2012). NOTE: Links to state regulatory websites are provided in Appendix B.

Table A-9. Summary of State and US Territory reuse regulations and guidelines* (Table 4-5 in USEPA 2012).

λ The state's regulations or guidelines intent is for the oversight of water reuse.
ο The state's regulations or guidelines intent is for the oversight of disposal and water reuse is incidental.
-- The state does not have water reuse regulations or guidelines but may permit reuse on a case-by-case basis.

State	Regulations	Guidelines	No Regulations or Guidelines (1)	Change from 2004 Edition	Urban Reuse – Unrestricted	Urban Reuse – Restricted	Agricultural Reuse – Food Crops	Agricultural Reuse – Processed Food Crops and Non-Food Crops	Impoundments – Unrestricted	Impoundments – Restricted	Environmental Reuse	Industrial Reuse	Groundwater Recharge – Nonpotable Reuse	Indirect Potable Reuse
Alabama		ο				ο		ο						
Alaska	ο							ο						
Arizona	λ			Update	λ	λ	λ	λ		λ	λ	λ	λ	λ
Arkansas	ο			New (2)			ο							
California	λ			Update	λ	λ	λ	λ	λ	λ		λ	λ	λ
Colorado	λ				λ	λ						λ		
Commonwealth of the Northern Mariana Islands (CNMI)	ο			(3)		ο		ο						
Connecticut			--											
Delaware	λ			Update	λ	λ	λ	λ	λ	λ		λ	ο	
District of Columbia			--											
Florida	λ			Update	λ	λ	λ	λ			λ	λ	λ	λ
Georgia		λ		Update	λ	λ		λ						
Guam				(4)										
Hawaii		λ			λ	λ	λ	λ		λ		λ	λ	λ
Idaho	λ			Update	λ	λ	λ	λ				λ	λ	
Illinois	λ				λ	λ		λ						
Indiana	ο			Update	ο	ο	ο	ο						
Iowa	λ					λ		λ						
Kansas		ο			ο	ο	ο	ο				ο		
Kentucky			--											
Louisiana			--								λ			
Maine			--											

State	Regulations	Guidelines	No Regulations or Guidelines (1)	Change from 2004 Edition	Urban Reuse – Unrestricted	Urban Reuse – Restricted	Agricultural Reuse – Food Crops	Agricultural Reuse – Processed Food Crops and Non-Food Crops	Impoundments – Unrestricted	Impoundments – Restricted	Environmental Reuse	Industrial Reuse	Groundwater Recharge – Nonpotable Reuse	Indirect Potable Reuse
Maryland		λ		Update	λ	λ		λ			λ	λ	λ	
Massachusetts	λ			New (2)	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ
Michigan	ο						ο	ο						
Minnesota		λ		5)	λ	λ	λ	λ	ο			λ		
Mississippi	ο					ο		ο				ο		
Missouri	λ					λ		λ		ο	ο	ο		
Montana	λ			Update (6)	λ	λ	λ	λ	λ	λ		λ	λ	
Nebraska	ο			Update	ο	ο	ο	ο	λ	λ		ο	λ	
Nevada	λ			Update	λ	λ		λ		λ	λ	λ		
New Hampshire			--											
New Jersey	λ	λ		New (7)	λ	λ	λ	λ				λ		
New Mexico		λ		Update (8)	λ	λ	λ	λ		λ	λ	λ		
New York			--	(9)										
North Carolina	λ			Update	λ	λ	λ	λ			λ	λ		
North Dakota		λ		Update	λ	λ		λ	λ		λ	λ	λ	
Ohio		λ			λ	λ		λ						
Oklahoma	λ			Update	λ	λ		λ				λ		
Oregon	λ			Update (10)	λ	λ	λ	λ	λ	λ		λ	λ	
Pennsylvania		λ			λ	λ	λ	λ	λ	λ	λ	λ		λ
Rhode Island		λ		New (11)	λ	λ		λ				λ		
South Carolina	λ				λ	λ		λ						
South Dakota		ο		Update		ο	ο	ο			ο		ο	
Tennessee		ο			Update	ο	ο		ο	ο	ο	ο		

State	Regulations	Guidelines	No Regulations or Guidelines (1)	Change from 2004 Edition	Urban Reuse – Unrestricted	Urban Reuse – Restricted	Agricultural Reuse – Food Crops	Agricultural Reuse – Processed Food Crops and Non-Food Crops	Impoundments – Unrestricted	Impoundments – Restricted	Environmental Reuse	Industrial Reuse	Groundwater Recharge – Nonpotable Reuse	Indirect Potable Reuse
Texas	λ			Update		λ	λ	λ	λ	λ	λ	λ		
Utah	λ						λ	λ	λ		λ	λ	λ		λ
Vermont	λ						λ		o					
Virginia	λ			New (13)		λ	λ	λ	λ	λ	λ	λ	λ	o	λ
Washington		λ		Update (14)		λ	λ	λ	λ	λ	λ	λ	λ	λ	λ
West Virginia	o			(15)				o	o						
Wisconsin	o			Update				o	o				o	o	
Wyoming	λ			Update		λ	λ	λ	λ				λ		

(1) Specific regulations or guidelines on reuse not adopted; however, reuse may be approved on a case-by-case basis
(2) The state had guidelines prior, and now has adopted regulations.
(3) CNMI regulations were not listed in the 2004 guidelines.
(4) Guam has regulations pertaining to Urban Restricted Reuse and Indirect Potable Reuse but they are not regulated by reuse or disposal regulations.
(5) Minnesota has been using the California rules as their Municipal Wastewater Reuse guidance since the mid 90's. This was not reflected in the 2004 guidelines, which indicated that Minnesota had no guidance.
(6) Montana is in the midst of promulgating new reuse regulations, which are anticipated to be finalized by the time of this publication.
(7) The state had guidelines prior, and now has adopted reuse regulations as well as guidelines.
(8) Reclaimed water projects in New Mexico are permitted under either a Ground Water Discharge Permit (which also controls use above ground) or a Construction Industries Permit if use in a building is included.
(9) Current interpretation is that New York has no regulations or guidelines.
(10) Groundwater recharge was added to Oregon's reuse regulations in 2008.
(11) The state previously had no guidelines or regulations and has adopted guidelines.
(12) Tennessee was listed as having regulations in the 2004 Guidelines; however, these were later deemed to be guidelines not regulations.
(13) The state previously had no guidelines or regulations and has adopted regulations.
(14) The Washington State currently has no regulations governing the use of reclaimed water. Draft regulations have been developed by the Department of Ecology in coordination with Department of Health and formal rules advisory committee. The draft rules are incomplete. Adoption of the rules has been delayed until after June 30, 2013. The reclaimed water use statute and formal standards, guidance and procedures adopted in 1997 remain in effect.
(15) In the 2004 guidelines West Virginia was listed as having regulations; however, these appear to be wastewater treatment regulations and do not specifically govern reuse.

* No information is available at this time on regulations or guidelines on water reuse promulgated by federally recognized tribal nations, Puerto Rico, the US Virgin Islands, and American Samoa.

Table A-9 also indicates that 27 states had updated or revised their current regulations or guidelines since a previous survey was reported (USEPA 2004). It is also important to point out that in states with no specific regulations or guidelines for

water reclamation and reuse, projects may still be permitted on a case-by-case basis. Likewise, some states that do not have rules will enable consideration of reuse options that are not specifically addressed within their existing rules or regulations.

Underlying objectives for regulations and guidelines vary considerably from state to state. Some states have developed regulations or guidelines and standards that strongly encourage water reuse as a conservation strategy. As a result, these states have developed comprehensive regulations or guidelines specifying water quality requirements, treatment processes, or both for the full spectrum of reuse applications. The states' objective is to derive maximum resource benefits of the reclaimed water, while still protecting the environment and public health.

Other states have regulations or guidelines that focus on land treatment of wastewater-derived effluent——emphasizing disposal rather than reuse——even though the effluent may be used for irrigation. There are many differences in the definition of reuse activities between states. The same practice may be considered reuse in one state but primarily a means of land treatment or disposal in another. In most states, the release of reclaimed water to a stream or other water body is still considered and permitted as a point source, despite the fact that it may create, enhance, or sustain the water bodies receiving that water.

Army installations may find it useful to view summaries of some of the leading water reuse states and their reclaimed water treatment and quality requirements. Ten states: Arizona, California, Florida, Hawaii, Nevada, New Jersey, North Carolina, Texas, Virginia, and Washington are presented in more detailed summaries. These states' regulations were chosen because they provide a collective wisdom of successful reuse programs and long-term experience. In addition to water quality and treatment requirements, states provide requirements or guidance on a wide range of other aspects of reuse, such as but not limited to: monitoring, reliability, storage, loading rates, and setback distances. Details are available at the individual state websites listed in Appendix B. All of the states presented have established types or levels of reclaimed water based on water quality. Table A-10—Table A-19 present information for these states.

Table A-10. Urban reuse – unrestricted (Table 4-7 in USEPA 2012).

		Arizona Class A	California Disinfected Tertiary	Florida	Hawaii R1 Water	Nevada Category A	New Jersey Type I RWBR	North Carolina Type 1	Texas Type 1	Virginia Level 1	Washington Class A
Treatment (System Design) Requirements	Unit processes	Secondary treatment, filtration, disinfection	Oxidized, coagulated, filtered, disinfected	Secondary treatment, filtration, high-level disinfection	Oxidized, filtered, disinfected	Secondary treatment, disinfection	Filtration, high-level disinfection	Filtration (or equivalent)	*NS*	Secondary treatment, filtration, high-level	Oxidized, coagulated, filtered, disinfected
	UV dose, if UV disinfection used	*NS*	NWRI UV Guidelines	NWRI UV Guidelines enforced, variance allowed	NWRI UV Guidelines	*NS*	100 mJ/cm^2 at max day flow	*NS*	*NS*	*NS*	NWRI UV Guidelines
	Chlorine disinfection requirements, if used	*NS*	C_rT > 450 mg·min/L; 90 minutes modal contact time at peak dry weather flow	TRC > 1 mg/L; 15 min. contact time at peak hr flow[1]	Min residual > 5 mg/L; 90 min, modal contact time	*NS*	Min residual > 1 mg/L; 15 min. contact time at peak hr flow	*NS*	*NS*	TRC CAT < 1 mg/L; 30 min. contact time at avg flow or 20 min. at peak flow	Chlorine residual > 1 mg/L; 30 min. contact time (C_rT > 30 may be required
Monitored Reclaimed Water Quality Requirements	BOD_5 (or $CBOD_5$)	*NS*	*NS*	$CBOD_5$: -20 mg/L (annl avg) -30 mg/L (mon avg) -45 mg/L (wk avg)	30 mg/L or 60 mg/L depending on design flow	30 mg/L (30-d avg)	NS	-10 mg/L (mon avg) -15 mg/L (daily max)	5 mg/L	10 mg/L (mon avg) or $CBOD_5$: 8 mg/L (mon avg)	30 mg/L
	TSS	*NS*	*NS*	5 mg/l (max)	30 mg/L or 60 mg/L depending on design flow	30 mg/L (30-d avg)	5 mg/l	-5 mg/l (mon avg) -10 mg/l (daily max)	*NS*	*NS*	30 mg/L; this limit is superseded by turbidity
	Turbidity	-2 NTU (24-hr avg) -5 NTU (max)	-2 NTU (avg) for media filters -10 NTU (max) for media filters -0.2 NTU (avg) for membrane filters -0.5 NTU (max) for membrane filters	Case-by-case (generally 2 to 2.5 NTU) Florida requires continuous on-line monitoring of turbidity as indicator for TSS	-2 NTU (95-percentile) -0.5 NTU (max)	*NS*	2 NTU (max) for UV	10 NTU (max)	3 NTU	-2 NTU (daily avg), CAT > 5 NTU	-2 NTU (avg) -5 NTU (max)

		Arizona Class A	California Disinfected Tertiary	Florida	Hawaii R1 Water	Nevada Category A	New Jersey Type I RWBR	North Carolina Type 1	Texas Type 1	Virginia Level 1	Washington Class A
Monitored Reclaimed Water Quality Requirements (cont'd)	Bacterial indicators	Fecal coliform: -none detectable in last 4 of 7 samples -23/100mL (max)	Total coliform: -2.2/100mL (7-day med) -23/100mL (not more than one sample exceeds this value in 30 d) -240/100mL (max)	Fecal coliform: -75% of samples below detection -25/100mL (max)	Fecal coliform: -2.2/100mL (7-day med) -23/100mL (not more than one sample exceeds this value in 30 d) -200/100mL (max)	Total coliform: -2.2/100mL (30-d 42eom.) -23/100mL (max)	Fecal coliform: -2.2/100mL (wk med) -14/100mL (max)	Fecal coliform or *E. coli*: -14/100mL (mon mean) -25/100mL (max)	Fecal coliform or *E. coli:* -20/100mL (30-d 42eom.) -75/100mL (max) *Enterococci:* -4/100mL (30-d 42eom.) -9/100mL (max)	Fecal coliform: -14/100mL (mon 42eom.), CAT > 49/100mL *E. coli:* -11/100mL (mon 42eom.), CAT > 35/100mL *Enterococci:* -11/100mL (mon 42eom.), CAT > 24/100mL	Total coliform -2.2/100mL (7-d med) -23/100mL (max)
	Pathogens	*NS*	*NS*	*Giardia* and *Cryptosporidium* sampling once each 2-yr period for plants ≥1 mgd; once each 5-yr	*TR*	*TR*	*NS*	*NS*	*NS*	*NS*	*NS*
	Other	If nitrogen > 10 mg/L, special requirements may be mandated to protect groundwater	-	-	-	-	(NH_3-N + NO_3-N) < 10 mg/L (max)	Ammonia as NH_3-N: -4 mg/L (mon avg) -6 mg/L (daily max)	-	-	Specific reliability or redundancy requirements based on formal reliability assessment

NS = not specified by the state's reuse regulation; TR = monitoring is not required but virus removal rates are prescribed by treatment requirements

[1] In Florida when chlorine disinfection is used, the product of the total chlorine residual and contact time (CrT) at peak hour flow is specified for three levels of fecal coliform as measured prior to disinfection. (See Section 6.4.3.1 for further discussion of CrT.) If the concentration of fecal coliform prior to disinfection: is ≤ 1,000 cfu per 100 mL, the CrT shall be 25 mg·min/L; is 1,000 to 10,000 cfu per 100 mL the CrT shall be 40 mg·min/L; and is ≥ 10,000 cfu per 100 mL the CrT shall be 120 mg·min/L.

Table A-11. Urban reuse – restricted (Table 4-8 in USEPA 2012).

		Arizona	California Disinfected Secondary–23	Florida[1]	Hawaii R2 Water	Nevada Category B	New Jersey Type II RWBR	North Carolina Type 1	Texas Type II	Virginia Level 2	Washington Class C
Treatment (System Design) Requirements	Unit Processes	Secondary treatment, disinfection	Oxidized, disinfected	*NS*	Oxidized, disinfected	Secondary treatment, disinfection	Case-by-case	Filtration (or equivalent)	*NS*	Secondary treatment, disinfection	Oxidized, disinfected
	UV dose, if UV disinfection used	*NS*	*NS*	*NS*	*NS*	*NS*	75mJ/cm^2 at max day flow	*NS*	*NS*	*NS*	NWRI UV Guidelines
	Chlorine disinfection requirements, if used	*NS*	*NS*	*NS*	Chlorine residual >5 mg/L; actual modal contact time of 10 min.	*NS*	Chlorine residual >1 mg/L; 15 min. contact time at peak hr flow	*NS*	*NS*	TRC CAT <1 mg/L; 30 min. contact time at avg flow or 20 min. at peak flow	Chlorine residual >1 mg/L; 30 min. contact time
Monitored Reclaimed Water Quality Requirements	BOD_5 (CBOD for Florida)	*NS*	*NS*	*NS*	30 mg/L or 60 mg/L depending on design flow	30 mg/L (30-d avg)	*NS*	-10 mg/L (mon avg) -15 mg/L (daily max)	Without pond: 20 mg/L (or $CBOD_5$ 15 mg/L); With pond: 30 mg/L	-30 mg/L (mon avg) -45 mg/L (max wk) or $CBOD_5$ -25 mg/L (mon avg) -40 mg/L (max wk)	30 mg/L
	TSS	*NS*	*NS*	*NS*	30 mg/L or 60 mg/L depending on design flow	30 mg/L (30-d avg)	30 mg/L	-5 mg/L (mon avg) -10 mg/L (daily avg)	*NS*	30 mg/L (mon avg) -45 mg/L (max wk)	30 mg/L

		Arizona	California Disinfected Secondary–23	Florida[1]	Hawaii R2 Water	Nevada Category B	New Jersey Type II RWBR	North Carolina Type 1	Texas Type II	Virginia Level 2	Washington Class C
Monitored Reclaimed Water Quality Requirements (cont'd)	Turbidity	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	10 NTU (max)	*NS*	*NS*	*NS*
	Bacterial indicators	Fecal coliform: -200/100mL in last 4 of 7 samples -800/100mL (max)	Total coliform: -23/100mL (7-d med) -240/100 (not more than one sample exceeds this value in 30 d)	*NS*	Fecal coliform: -23/100mL (7-day med) -200/100 mL (not more than one sample exceeds this value in 30 d)	Fecal coliform: - 2.2/100mL (30-d 44age) -23/100mL (max)	Fecal coliform: -200/100mL (mon 44age) -400/100mL (wk 44age)	Fecal coliform or *E. coli*: -14/100mL (mon mean) -25/100mL (daily max)	Fecal coliform or *E. coli:* -200/100mL (30-d 44age) -800/100mL (max) *Enterococci:* -35/100 mL (30-d 44age) -89/100 mL (max)	Fecal coliform: -200/100mL (mon 44age), CAT > 800/100 mL *E. coli*: -126/100mL (mon 44age), CAT > 235/100 mL *Enterococci:* -35/100mL (mon 44age), CAT > 104/100 mL	Total coliform: -23/100 mL (7-d med) -240/100 mL (max)
	Other	If nitrogen > 10 mg/L, special req. may be mandated to protect groundwater	—	—	—	—	(NH_3-N + NO_3-N): < 10 mg/L (max)	Ammonia as NH_3-N: -4 mg/L (mon avg) -6 mg/L (daily max)	—	—	—

NS = not specified by the state reuse regulation

[1] Florida does not specifically include urban reuses in its regulations for restricted public access under F.A.C. 62-610-400; requirements for restricted public access reuse are provided in Agricultural Reuse – Non-food Crops, Table 4-9.

[2] There is no expressed designation between unrestricted and restricted urban reuse in North Carolina regulations.

Table A-12.Agricultural reuse – food crops (Table 4-9 in USEPA 2012).

		Arizona Class A	California Disinfected Tertiary	Florida[11]	Hawaii R1 Water	Nevada	New Jersey Type II RWBR	North Carolina		Texas[1] Type I Reclaimed Water	Virginia[3] Level 1	Washington Class A
								Processed Type 1	NOT Processed Type 2			
Treatment (System Design) Requirements	Unit Processes	Secondary treatment, filtration, disinfection	Oxidized, coagulated, filtered, disinfected	Secondary treatment, filtration, high-level disinfection	Oxidized, filtered, disinfected	*NP*	Filtration, high-level disinfection	Filtration (or equivalent)	Filtration, dual UV chlorination (or equiv.)	*NS*	Secondary treatment, filtration, high-level disinfection	Oxidized, coagulated, filtered, disinfected
	UV dose, if UV disinfection used	*NS*	NWRI UV Guidelines	NWRI UV Guidelines enforced, variance allowed	NWRI UV Guidelines	*NP*	100 mJ/cm^2 at max day flow	*NS*	dual UV chlorination (or equiv.)	*NS*	*NS*	NWRI UV Guidelines
	Chlorine disinfection requirements, if used	*NS*	CrT > 450 mg•min/L; 90 minutes modal contact time at peak dry weather flow	TRC > 1 mg/L; 15 minutes contact time at peak hr flow[2]	Min residual > 5 mg/L, actual modal contact time of 90 minutes	*NP*	Min residual > 1 mg/L; 15 minutes contact at peak hr flow	*NS*	dual UV chlorination (or equiv.)	*NS*	TRC CAT <1 mg/L; 30 min. contact time at avg flow or 20 min. at peak flow	Chlorine residual >1 mg/L; 30 min. contact time
Monitored Reclaimed Water Quality Requirements	BOD_5 (CBOD for Florida)	*NS*	*NS*	$CBOD_5$: -20 mg/L (ann avg) -30 mg/L (mon avg) -45 mg/L (wk avg) -60 mg/L (max)	30 mg/L or 60 mg/L depending on design flow	*NP*	*NS*	-10 mg/L (mon avg) -15 mg/L (daily max)	-5 mg/L (mon avg) -10 mg/L (daily max)	5 mg/L	10 mg/L (mon avg) or $CBOD_5$: 8 mg/L (mon avg)	30 mg/L
	TSS	*NS*	*NS*	5 mg/L (max)	30 mg/L or 60 mg/L depending on design flow	*NP*	5 mg/L	-5 mg/L (mon avg) -10 mg/L (daily max)	-5 mg/L (mon avg) -10 mg/L (daily max)	*NS*	*NS*	30 mg/L

		Arizona Class A	California Disinfected Tertiary	Florida[11]	Hawaii R1 Water	Nevada	New Jersey Type II RWBR	North Carolina		Texas[1] Type I Reclaimed Water	Virginia[3] Level 1	Washington Class A
								Processed Type 1	NOT Processed Type 2			
Monitored Reclaimed Water Quality Requirements (cont'd)	Turbidity	-2 NTU (24-hr avg) -5 NTU (max)	-2 NTU (avg) for media filters -10 NTU (max) for media filters -0.2 NTU (avg) for membrane filters -0.5 NTU (max) for membrane filters	Case-by-case (generally 2 to 2.5 NTU) ; Florida requires continuous on-line monitoring of turbidity as indicator for TSS	-2 NTU (95-percentile) -0.5 NTU (max)	*NP*	2 NTU (max) for UV	10 NTU (max)	5 NTU (max)	3 NTU	2 NTU (daily avg) CAT > 5 NTU	-2 NTU (avg) -5 NTU (max)
	Bacterial indicators	Fecal coliform: -none detectable in last 4 of 7 samples -23/100mL (max)	Total coliform: -2.2/100mL (7-day med) -23/100mL (not more than one sample exceeds this value in 30 d) -240/100mL (max)	Fecal coliform: -75% of samples below detection -25/100mL (max)	Fecal coliform: -2.2/100mL (7-day med) -23/100mL (not more than one sample exceeds this value in 30 d) -200/100mL (max)	*NP*	Fecal coliform: -2.2/100mL (wk med) -14/100mL (max)	Fecal coliform or *E. coli*: -14/100mL (mon mean) -25/100mL (daily max)	Fecal coliform or *E. coli:* -3/100mL (mon mean) -25/100mL (mon mean)	Fecal coliform or *E. coli*: -20/100mL (30-d 46age) -75/100mL (max) *Enterococci:* -4/100mL (30-d 46age) -9/100mL (max)	Fecal coliform: -14/100mL (mon 46age), CAT > 49/100mL E. coli: -11/100mL (mon 46age), CAT > 35/100mL Enterococci: -11/100mL (mon 46age), CAT > 24/100mL	Total coliform: -2.2/100mL (7-d med) -23/100mL (max)

		Arizona Class A	California Disinfected Tertiary	Florida[11]	Hawaii R1 Water	Nevada	New Jersey Type II RWBR	North Carolina		Texas[1] Type I Reclaimed Water	Virginia[3] Level 1	Washington Class A
								Processed Type 1	NOT Processed Type 2			
Monitored Reclaimed Water Quality Requirements (cont'd)	Viral indicators	*NS*	*NS*	*nS*	*TR*	*NP*	*NS*	*NS*	Coliphage: - 5/100mL (mon mean) - 25/100mL (daily max)	*NS*	*NS*	*NS*
	Pathogens	*NS*	*NS*	*Giardia, Cryptosporidium* sampling once per 2-yr period for plants ≥ 1 mgd; once per 5-yr period for plants ≤ 1 mgd	—	*NP*	*NS*	*NS*	Clostridium: - 5/100mL (mon mean) - 25/100mL (daily max)	*NS*	*NS*	*NS*
	Other	If nitrogen > 10 mg/L, special req. may be mandated to protect groundwater	—	—	—	—	(NH_3-N + NO_3-N): < 10 mg/L (max)			—	—	—

NS = not specified by the state's reuse regulation; TR = monitoring is not required but virus removal rates are prescribed by treatment requirement; NP = not permitted by the state

[1] In Texas and Florida, spray irrigation (i.e., direct contact) is not permitted on foods that may be consumed raw (except Florida makes an exception for citrus and tobacco), and only irrigation types that avoid reclaimed water contact with edible portions of food crops(such as drip irrigation) are acceptable.

[2] In Florida when chlorine disinfection is used, the product of the total chlorine residual and contact time (CrT) at peak hour flow is specified for three levels of fecal coliform as measured prior to disinfection. (See Section 6.4.3.1 for further discussion of CrT.) If the concentration of fecal coliform prior to disinfection: is ≤ 1,000 cfu per 100 mL, the CrT shall be 25 mg·min/L; is 1,000 to 10,000 cfu per 100 mL the CrT shall be 40 mg·min/L; and is ≥ 10,000 cfu per 100 mL the CrT shall be 120 mg·min/L.

[3] The requirements presented for Virginia are for food crops eaten raw. There are different requirements for food crops that are processed, which are presented in Table 4-10.

Table A-13. Agricultural reuse – non-food crops and processed food crops (where permitted) (Table 4-10 in USEPA 2012).

		Arizona		California Undisinfected Secondary	Florida	Hawaii R2 Water	Nevada[2] Category E	New Jersey Type II RWBR	North Carolina Type 1	Texas Type II	Virginia Level 2	Washington Class C
Treatment (System Design) Requirements	Unit Processes	Secondary treatment, disinfection	Secondary treatment, with or without disinfection	Oxidized	Secondary treatment, basic disinfection	Secondary 23: oxidized, disinfected	Secondary treatment[1]	Case-by-case	Filtration (or equivalent)	*NS*	Secondary treatment, disinfection	Oxidized, disinfected
	UV dose, if UV disinfection used	*NS*	*NS*		*NS*	*NS*	*NS*	75mJ/cm^2 at max day flow	*NS*	*NS*	*NS*	NWRI UV Guidelines
	Chlorine disinfection requirements, if used	*NS*	*NS*	*NS*	TRC >0.5 mg/L; 15 min. contact time at peak hr flow[1]	Chlorine residual >5 mg/L; 10 min. actual modal contact time	*NS*	Chlorine residual >1 mg/L; 15 min. contact time at peak hr flow	*NS*	*NS*	TRC CAT <1 mg/L; 30 min. contact time at avg flow or 20 min. at peak flow	Chlorine residual >1 mg/L; 30 min. contact time
Monitored Reclaimed Water Quality Requirements	BOD_5 (or $CBOD_5$)	*NS*	*NS*	*NS*	CBOD5: -20 mg/L (ann avg) -30 mg/L (mon avg) -45 mg/L (wk avg) -60 mg/L (max)	30 mg/L or 60 mg/L depending on design flow	30 mg/L (30-d avg)	*NS*	-10 mg/L (mon avg) -15 mg/L (daily max)	Without pond: 20 mg/L (or $CBOD_5$ 15 mg/L); With pond: 30 mg/L	-30 mg/L (mon avg) -45 mg/L (max wk) or CBOD5 -25 mg/L (mon avg) -40 mg/L (max wk)	30 mg/L
	TSS	*NS*	*NS*	*NS*	-20 mg/L (ann avg) -30 mg/L (mon avg) -45 mg/L (wk avg) -60 mg/L (max)	30 mg/L or 60 mg/L depending on design flow	30 mg/L (30-d avg)	30 mg/L	-5 mg/L (mon avg) -10 mg/L (daily avg)	*NS*	30 mg/L (mon avg) -45 mg/L (max wk)	30 mg/L

		Arizona		California Undisinfected Secondary	Florida	Hawaii R2 Water	Nevada[2] Category E	New Jersey Type II RWBR	North Carolina Type 1	Texas Type II	Virginia Level 2	Washington Class C
Monitored Reclaimed Water Quality Requirements (cont'd)	Turbidity	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	10 NTU (max)	*NS*	*NS*	*NS*
	Bacterial indicators	Fecal coliform: -200/100mL in last 4 of 7 samples -800/100mL (max)	Fecal coliform: -1000/ 100mL in last 4 of 7 samples -4000/ 100mL (max)	*NS*	Fecal coliform: -200/100mL (avg) -800/100mL (max)	Fecal coliform: -23/100mL (7-day med) -200/100mL (not more than one sample exceeds this value in 30 d)	*NS*	Fecal coliform: -200/100mL (mon 49age) -400/100mL (wk 49age)	Fecal coliform or *E. coli*: -14/100mL (mon mean) -25/100mL (daily max)	Fecal coliform or *E. coli:* -200/100mL (30-d 49age) -800/100mL (max) *Enterococci:* -35/100 mL (30-d 49age) -89/100 mL (max)	Fecal coliform: -200/100mL (mon 49age), CAT > 800/100 mL *E. coli*: -126/100mL (mon 49age), CAT > 235/100 mL *Enterococci:* -35/100mL (mon 49age), CAT > 104/100 mL	Total coliform: -23/100 mL (7-d med) -240/100 mL (max)
	Other	If nitrogen > 10 mg/L, special req. may be mandated to protect groundwater	If nitrogen > 10 mg/L, special 49age s4949ent may be mandated to protect groundwate r	—	—	—	—	(NH_3-N + NO_3-N):< 10 mg/L (max)	Ammonia as NH_3-N: -4 mg/L (mon avg) -6 mg/L (daily max)	—	—	—

NS = not specified by the state's reuse regulation

[1] In Florida when chlorine disinfection is used, the product of the total chlorine residual and contact time (CrT) at peak hour flow is specified for three levels of fecal coliform as measured prior to disinfection. (See Section 6.4.3.1 for further discussion of CrT.) If the concentration of fecal coliform prior to disinfection: is ≤ 1,000 cfu per 100 mL, the CrT shall be 25 mg·min/L; is 1,000 to 10,000 cfu per 100 mL the CrT shall be 40 mg·min/L; and is ≥ 10,000 cfu per 100 mL the CrT shall be 120 mg·min/L.

[2] Nevada prohibits public access and requires a minimum buffer zone of 800 feet for spray irrigation of non-food crops. (Category E, NAC 445A.2771).

Table A-14. Impoundments – unrestricted (Table 4-11 in USEPA 2012).

		Arizona[1] Class A	California Disinfected Tertiary	Florida	Hawaii	Nevada	New Jersey	North Carolina	Texas Type I	Virginia Level 1	Washington Class A
Treatment (System Design) Requirements	Unit Processes	Secondary treatment, disinfection	Oxidized, coagulated, filtered, disinfected[2]	*NR*	*NR*	*NP*	*NR*	*NS*	*NS*	Secondary treatment, filtration, high-level disinfection	Oxidized, coagulated, filtered and disinfected
	UV dose, if UV disinfection used	*NS*	NWRI UV Guidelines	*NR*	*NR*	*NP*	*NR*	*NS*	*NS*	*NS*	NWRI UV Guidelines
	Chlorine disinfection requirements, if used	*NS*	CrT > 450 mg•min/L; 90 minutes modal contact time at peak dry weather flow	*NR*	*NR*	*NP*	*NR*	*NS*	*NS*	TRC CAT < 1 mg/L after minimum contact time of 30 min. at avg flow or 20 min. at peak flow	Chlorine residual > 1 mg/L; 30 minutes contact time
Monitored Reclaimed Water Quality Requirements	BOD_5	*NS*	*NS*	*NR*	*NR*	*NP*	*NR*	*NS*	5 mg/L	10 mg/L (mon avg) or CBOD5: 8 mg/L (mon avg)	30 mg/L
	TSS	*NS*	*NS*	*NR*	*NR*	*NP*	*NR*	*NS*	*NS*	*NS*	30 mg/L

		Arizona[1] Class A	California Disinfected Tertiary	Florida	Hawaii	Nevada	New Jersey	North Carolina	Texas Type I	Virginia Level 1	Washington Class A
Monitored Reclaimed Water Quality Requirements (cont'd)	Turbidity	*NS*	-2 NTU (avg) for media filters -10 NTU (max) for media filters -0.2 NTU (avg) for membrane filters -0.5 NTU (max) for membrane filters	*NR*	*NR*	*NP*	*NR*	*NS*	3 NTU	2 NTU (daily avg), CAT > 5 NTU	-2 NTU (avg) -5 NTU (max)
	Bacterial indicators	Fecal coliform: -none detectable in last 4 of 7 samples; -23/100mL (max)	Total coliform: -2.2/100mL (7-day med) -23/100mL (not more than one sample exceeds this value in 30 d) -240/100mL (max)	*NR*	*NR*	*NP*	*NR*	*NS*	Fecal coliform or *E.coli:* -20/100mL (avg) -75/100mL (max) *Enterococci:* -4/100mL (avg) -9/100mL (max)	Fecal coliform: -14/100mL (mon 52age), CAT > 49/100mL *E. coli:* -11/100mL (mon 52age), CAT > 35/100mL *Enterococci:* -11/100mL (mon 52age), CAT > 24/100mL	Total coliform: -2.2/100mL (7-day med) -23/100mL (max)
	Other	If nitrogen > 10 mg/L, special requirements may be mandated to protect groundwater	Supplemental pathogen monitoring	—	—	*NP*	*NR*	—	—	—	Specific reliability and redundancy requirements based on formal assessment

NS = not specified by the state's reuse regulation; NR = not regulated by the state under the reuse program; NP = not permitted by the state

[1] Arizona does not allow reuse for swimming or "other full-immersion water activity with a potential of ingestion" [AAC R18-9-704(G)(1)(b)]. Arizona also allows "Class A" and "A+" waters to be used for snowmaking, which is included in this definition.

[2] Disinfected tertiary recycled water that has not received conventional treatment shall be sampled/analyzed monthly for *Giardia*, enteric viruses, and *Cryptosporidium* during first 12 months of operation and use. Following the first 12 months, samples will be collected quarterly and ongoing monitoring may be discontinued after the first two years, with approval.

Table A-15. Impoundments – restricted (Table 4-12 in USEPA 2012).

		Arizona Class B	California Disinfected Secondary–2.2	Florida	Hawaii R-2 Water	Nevada Category A	New Jersey	North Carolina	Texas Type II	Virginia Level 2	Washington Class B
Treatment (System Design) Requirements	Unit Processes	Secondary treatment, disinfection	Oxidized, disinfected[2]	*NR*	Oxidized, disinfected[2]	Secondary treatment, disinfection	*NR*	*NS*	*NS*	Secondary treatment, disinfection	Oxidized, disinfected
	UV dose, if UV disinfection used	*NS*	*NS*	*NR*	*NS*	*NS*	*NR*	*NS*	*NS*	*NS*	NWRI UV Guidelines
	Chlorine disinfection requirements, if used	*NS*	*NS*	*NR*	Chlorine residual > 5 mg/L; actual modal contact time of 10 minutes	*NS*	*NR*	*NS*	*NS*	TRC CAT < 1 mg/L after minimum contact time of 30 min. at avg flow or 20 min. at peak flow	Chlorine residual > 1 mg/L; 30 minutes contact time
Monitored Reclaimed Water Quality Requirements	BOD_5	*NS*	*NS*	*NR*	30 mg/L or 60 mg/L depending on design flow	30 mg/L (30-d avg)	*NR*	*NS*	Without pond: 20 mg/L (or CBOD5 15 mg/L) With pond: 30 mg/L	30 mg/L (mon avg) 45 mg/L (max wk) or CBOD5: 25 mg/L (mon avg) 40 mg/L (max wk)	30 mg/L
	TSS	*NS*	*NS*	*NR*	30 mg/L or 60 mg/L depending on design flow	30 mg/L (30-d avg)	*NR*	*NS*	*NS*	30 mg/L (mon avg) 45 mg/L (max wk)	30 mg/L

		Arizona Class B	California Disinfected Secondary–2.2	Florida	Hawaii R-2 Water	Nevada Category A	New Jersey	North Carolina	Texas Type II	Virginia Level 2	Washington Class B
Monitored Reclaimed Water Quality Requirements (cont'd)	Turbidity	*NS*	*NS*	*NR*	*NS*	*NS*	*NR*	*NS*	*NS*	*NS*	*NS*
	Bacterial indicators	Fecal coliform: -200/100mL in last 4 of 7 samples -800/100mL (max)	Total coliform: -2.2/100mL (7-day med) -23/100mL (not more than one sample exceeds this value in 30 d)	*NR*	Fecal coliform: -23/100mL (7-day med) -200/100mL (not more than one sample exceeds this value in 30 d)	Total coliform: -2.2/100mL (30-d 55age) -23/100mL (max)	*NR*	*NS*	Fecal coliform or *E. coli*: -200/100mL (30-d 55age) -800/100mL (max) *Enterococci:* -35/100mL (30-d 55age) -89/100mL (max)	Fecal coliform: -14/100mL (mon 55age), CAT > 49/100mL *E. coli:* -11/100mL (mon 55age), CAT > 35/100mL *Enterococci:* -11/100mL (mon 55age), CAT > 24/100mL	Total coliform: -2.2/100 mL (7-day med) -23/100 mL (max)
	Other	If nitrogen > 10 mg/L, special requirements may be mandated to protect groundwater	—	—	—	—	*NR*	—	—	—	Specific reliability and redundancy requirements based on formal assessment

NS = not specified by the state's reuse regulation; NR = not regulated by the state under the reuse program; TR = monitoring is not required but virus removal rates are prescribed by treatment requirements

Table A-16. Environmental reuse (Table 4-13 in USEPA 2012).

		Arizona [1]	California	Florida [2]	Hawaii	Nevada Category C	New Jersey	North Carolina Type 1	Texas	Virginia [4]	Washington Class A
Treatment (System Design) Requirements	Unit Processes	*NR*	*NR*	Secondary treatment, nitrification, basic disinfection	*NR*	Secondary treatment, disinfection	*NR*	Filtration (or equivalent)	*NR*	*NS*	Oxidized, coagulated, filtered, disinfected
	UV dose, if UV disinfection used	*NR*	*NR*	*NS*	*NR*	*NS*	*NR*	*NS*	*NR*	*NS*	NWRI UV Guidelines
	Chlorine disinfection requirements., if used	*NR*	*NR*	TRC > 0.5 mg/L; 15 minutes contact time at peak hr flow[3]	*NR*	*NS*	*NR*	*NS*	*NR*	*NS*	Chlorine residual > 1 mg/L; 30 minutes contact time
Monitored Reclaimed Water Quality Requirements	BOD_5 (or $CBOD_5$)	*NS*	*NS*	$CBOD_5$: -5 mg/L (ann avg) -6.25 mg/L (mon avg) -7.5 mg/L (wk avg) -10 mg/L (max)	*NR*	30 mg/L (30-d avg)	*NR*	-10 mg/L (mon avg) -15 mg/L (daily max)	*NR*	*NS*	20 mg/L
	TSS	*NR*	*NR*	-5 mg/L (ann avg) -6.25 mg/L (mon avg) -7.5 mg/L (wk avg) -10 mg/L (max)	*NR*	30 mg/L (30-d avg)	*NR*	-5 mg/L (mon avg) -10 mg/L (daily max)	*NR*	*NS*	20 mg/L
	Bacterial Indicators	*NR*	*NR*	Fecal coliform: -200/100mL (avg) -800/100mL (max)	*NR*	Fecal coliform: -23/100mL (30-d 56age) -240/100mL (max)	*NR*	Fecal coliform or E. coli: -14/100mL (mon mean) -25/100mL (daily max)	*NR*	*NS*	Total coliform: -2.2/100mL (7-d med) -23/100mL (max)

		Arizona [1]	California	Florida [2]	Hawaii	Nevada Category C	New Jersey	North Carolina Type 1	Texas	Virginia [4]	Washington Class A
Monitored Reclaimed Water Quality Requirements (cont'd)	Total Ammonia	*NR*	*NR*	-2 mg/L (ann avg) -2 mg/L (mon avg) -3 mg/L (wk avg) -4 mg/L (max)	*NR*	*NS*	*NR*	Ammonia as NH_3-N: -4 mg/L (mon avg) -6 mg/L (daily max)	*NR*	*NS*	Not to exceed chronic standards for freshwater
	Nutrients	*NR*	*NR*	Phosphorus: -1 mg/L (ann avg) -1.25 mg/L (mon avg) -1.5 mg/L (wk avg) -2 mg/L (max) Nitrogen: -3 mg/L (ann avg) -3.75 mg/L (mon avg) -4.5 mg/L (wk avg) -6 mg/L (max)	*NR*	*NS*	*NR*	Phosphorus: 1 mg/L (max)[5] Nitrogen: 4 mg/L (max)[5]	*NR*	*NS*	Phosphorus: 1 mg/L (ann avg)[6]

NS = not specified by the state's reuse regulation; NR = not regulated by the state under the reuse program

[1] Though Arizona reuse regulations do not specifically cover environmental reuse, treated wastewater effluent meeting Arizona's reclaimed water classes is discharged to waters of the US and creates incidental environmental benefits. Arizona's NPDES Surface Water Quality Standards includes a designation for this type of water, "Effluent Dependent Waters."

[2] Florida requirements are for a natural receiving wetland regulated under Florida Administrative Code Chapter 62-611 for Wetlands Application.

[3] In Florida when chlorine disinfection is used, the product of the total chlorine residual and contact time (CrT) at peak hour flow is specified for three levels of fecal coliform as measured prior to disinfection. (See Section 6.4.3.1 for further discussion of CrT.) If the concentration of fecal coliform prior to disinfection: is ≤ 1,000 cfu per 100 mL, the CrT shall be 25 mg·min/L; is 1,000 to 10,000 cfu per 100 mL the CrT shall be 40 mg·min/L; and is ≥ 10,000 cfu per 100 mL the CrT shall be 120 mg·min/L.

[4] Wetlands in Virginia, whether natural or created as mitigation for impacts to existing wetlands, are considered state surface waters; release of reclaimed water into a wetland is regulated as a point source discharge and subject to applicable surface water quality standards of the state.

[5] These limits are not to be exceeded unless net environmental benefits are provided by exceeding these limits.

[6] The phosphorous limit is as an annual average for wetland augmentation/restoration while for stream flow augmentation is the same as that required to NPDES discharge limits, or in other words variable.

Table A-17. Industrial reuse[1] (Table 4-14 in USEPA 2012).

		Arizona [2]	California [3] Disinfected Tertiary	Florida [3]	Hawaii [1] R-2 Water	Nevada Category E	New Jersey Type IV RWBR	North Carolina Type 1	Texas [1,5] Type II	Virginia [6] Level 2	Washington[5] Class A
Treatment (System Design) Requirements	Unit Processes	Individual Reclaimed Water Permit, case-specific[2]	Oxidized, coagulated, filtered, disinfected	Secondary treatment, filtration, high-level disinfection	Oxidized, disinfected	Secondary treatment, disinfection	Case-by-case	Filtration (or equivalent), unless there is no public access or employee exposure	*NS*	Secondary treatment, disinfection	Oxidized, coagulated, filtered and disinfected
	UV dose, if UV disinfection used	*NS*	NWRI UV Guidelines	NWRI UV Guidelines, variance allowed	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	NWRI UV Guidelines
	Chlorine disinfection requirements., if used	*NS*	CrT > 450 mg•min/L; 90 minutes modal contact time at peak dry weather flow	TRC > 0.5 mg/L; 15 minutes contact time at peak hr flow[4]	Chlorine residual > 5 mg/L, actual modal contact time of 10 minutes	*NS*	*NS*	*NS*	*NS*	TRC CAT < 1 mg/L; 30 minutes contact time at avg flow or 20 minutes at peak flow	Chlorine residual > 1 mg/L; 30 minutes contact time
Monitored Reclaimed Water Quality Requirements	BOD_5 (or $CBOD_5$)	*NS*	*NS*	CBOD5: -20 mg/L (ann avg) -30 mg/L (mon avg) -45 mg/L (wk avg) -60 mg/L (max)	30 mg/L or 60 mg/L depending on design flow	30 mg/L (30-d avg)	*NS*	-10 mg/L (mon avg) -15 mg/L (daily max)	Without pond: 20 mg/L (or CBOD5 15 mg/L) With pond: 30 mg/L	-30 mg/L (mon avg) -45 mg/L (max wk) or $CBOD_5$: -25 mg/L (mon avg) -40 mg/L (max wk)	30 mg/L
	TSS	*NS*	*NS*	-5 mg/L (max)	30 mg/L or 60 mg/L depending on design flow	30 mg/L (30-d avg)	Case-by-case	-5 mg/L (mon avg) -10 mg/L (daily max)	*NS*	-30 mg/L (mon avg) -45 mg/L (max wk)	30 mg/L

		Arizona [2]	California [3] Disinfected Tertiary	Florida [3]	Hawaii [1] R-2 Water	Nevada Category E	New Jersey Type IV RWBR	North Carolina Type 1	Texas [1,5] Type II	Virginia [6] Level 2	Washington[5] Class A
Monitored Reclaimed Water Quality Requirements (cont'd)	Turbidity	*NS*	-2 NTU (avg) for media filters -10 NTU (max) for media filters -0.2 NTU (avg) for membrane filters -0.5 NTU (max) for membrane filters	Case-by-case (generally 2 to 2.5 NTU) Florida requires continuous on-line monitoring of turbidity as indicator for TSS	*NS*	*NS*	*NS*	10 NTU (max)	*NS*	*NS*	-2 NTU (avg) -5 NTU (max)
	Bacterial Indicators	*NS*	Total coliform: -2.2/100mL (7-day med) -23/100mL (not more than one sample exceeds this value in 30 d) -240/100mL (max)	Fecal coliform: -75% of samples below detection -25/100mL (max)	Fecal coliform: -23/100mL (7-day med) -200/100mL (not more than one sample exceeds this value in 30 d)	Fecal coliform: -23/100mL (30-d 59age) -240/100mL (max)	*NS*	Fecal coliform or E. coli: -14/100mL (mon mean) -25/100mL (daily max)	Fecal coliform or *E. coli:* -200/100mL (30-d 59age) -800/100mL (max) *Enterococci:* -35/100mL (30-d 59age) -89/100mL (max)	Fecal coliform: -200/100mL (mon goem), CAT > 800/100mL *E. coli:* 126/100mL (mon 59age), CAT > 235/100mL *Enterococci:* -35/100mL (mon 59age) -CAT > 104/100mL	Total coliform: -2.2/100mL (7-d med) -23/100mL (max)
	Pathogens	*NS*	*NS*	Giardia, Cryptosporidium sampling once each 2-yr period if high-level disinfection is required	*NS*	*TR*	*NS*	*NS*	*NS*	*NS*	*NS*

NS = not specified by the state's reuse regulation; NR = not regulated by the state under the reuse program

[1] Though Arizona reuse regulations do not specifically cover environmental reuse, treated wastewater effluent meeting Arizona's reclaimed water classes is discharged to waters of the US and creates incidental environmental benefits. Arizona's NPDES Surface Water Quality Standards includes a designation for this type of water, "Effluent Dependent Waters.

[2] Florida requirements are for a natural receiving wetland regulated under Florida Administrative Code Chapter 62-611 for Wetlands Application.

[3] In Florida when chlorine disinfection is used, the product of the total chlorine residual and contact time (CrT) at peak hour flow is specified for three levels of fecal coliform as measured prior to disinfection. (See Section 6.4.3.1 for further discussion of CrT.) If the concentration of fecal coliform prior to disinfection: is ≤ 1,000 cfu per 100 mL, the CrT shall be 25 mg·min/L; is 1,000 to 10,000 cfu per 100 mL the CrT shall be 40 mg·min/L; and is ≥ 10,000 cfu per 100 mL the CrT shall be 120 mg·min/L.

[4] Wetlands in Virginia, whether natural or created as mitigation for impacts to existing wetlands, are considered state surface waters; release of reclaimed water into a wetland is regulated as a point source discharge and subject to applicable surface water quality standards of the state.

[5] These limits are not to be exceeded unless net environmental benefits are provided by exceeding these limits.

[6] The phosphorous limit is as an annual average for wetland augmentation/restoration while for stream flow augmentation is the same as that required to NPDES discharge limits, or in other words variable.

Table A-18. Groundwater recharge – nonpotable reuse[1] (Table 4-15 in USEPA 2012).

		Arizona [2]	California	Florida [3]	Hawaii	Nevada	New Jersey[5]	North Carolina	Texas	Virginia [6]	Washington Class A
Treatment (System Design) Requirements	Unit Processes	Regulated by Aquifer Protection Permit[2]	Case-by-case	Secondary treatment, basic disinfection	Case-by-case	*ND*	*NR*	Aquifer Storage and Recovery in accordance with G.S. 143-214.2.	*Nr*	*NS*	Oxidized, coagulated, filtered, nitrogen reduced, disinfected
	UV dose, if UV disinfection used	*NS*	*NS*	*NS*	*NS*	*ND*	*NR*	*NR*	*NR*	*NS*	NWRI UV Guidelines
	Chlorine disinfection requirements., if used	*NS*	*NS*	TRC > 0.5 mg/L; 15 minutes contact time at peak hr flow[4]	*NS*	*ND*	*NR*	*NR*	*NR*	*NS*	Chlorine residual > 1 mg/L; 30 min. contact time at peak hr flow
Monitored Reclaimed Water Quality Requirements	BOD_5 (or $CBOD_5$)	*NS*	*NS*	CBOD5: -20 mg/L (ann avg) -30 mg/L (mon avg) -45 mg/L (wk avg) -60 mg/L (max)	*NS*	*ND*	*NR*	*NR*	*NR*	*NS*	5 mg/L
	TSS	*NS*	*NS*	-20 mg/L (ann avg) -30 mg/L (mon avg) -45 mg/L (wk avg) -60 mg/L (max)	*NS*	*ND*	*NR*	*NR*	*NR*	*NS*	5 mg/L
	Turbidity	*NS*	*NS*	*NS*	*NS*	*ND*	*NR*	*NR*	*NR*	*NS*	-2 NTU (avg) -5 NTU (max)

		Arizona [2]	California	Florida [3]	Hawaii	Nevada	New Jersey[5]	North Carolina	Texas	Virginia [6]	Washington Class A
Monitored Reclaimed Water Quality Requirements (cont'd)	Bacterial Indicators	*NS*	*NS*	Fecal coliform: -200/100mL (avg) -800/100mL (max)	*NS*	*ND*	*NR*	*NR*	*NR*	*NS*	Total coliform: -2.2/100mL (7-d med) -23/100mL (max day)
	Total Nitrogen	*NS*	*NS*	NS (nitrate < 12 mg/L)	*NS*	*ND*	*NR*	*NR*	*NR*	*NS*	Case-by-case
	TOC	*NS*	*NS*	*NS*	*NS*	*ND*	*NR*	*NR*	*NR*	*NS*	Case-by-case
	Primary and Secondary Drinking Water Standards	*NS*	*NS*	*NS*	*NS*	*ND*	*NR*	*NR*	*NR*	*NS*	Case-by-case

NR = not regulated by the state under the reuse program; ND = regulations have not been developed for this type of reuse; NS = not specified by the state's reuse regulation

[1] All state requirements are for groundwater recharge of a nonpotable aquifer.

[2] Groundwater recharge using reclaimed water is pervasive in Arizona but is not considered part of the reclaimed water program; Arizona Department of Environmental Quality (ADEQ) regulates quality under the Department's Aquifer Protection Permit Program (which governs all discharges that might impact groundwater). The Arizona Department of Water Resources (ADWR) oversees a program to limit withdrawals of groundwater to prevent groundwater depletion; municipalities and other entities can offset these pumping limitations by recharging reclaimed water through detailed permits under its Recharge Program.

[3] Higher treatment standards may be require, such as filtration, high level disinfection, total nitrogen below 10 mg/L, and meeting primary and secondary drinking water standards, if there may be a connection to a potable aquifer or other conditions such as groundwater recharge overlying the Biscayne Aquifer in Southeast Florida.

[4] In Florida when chlorine disinfection is used, the product of the total chlorine residual and contact time (CrT) at peak hour flow is specified for three levels of fecal coliform as measured prior to disinfection. (See Section 6.4.3.1 for further discussion of CrT.) If the concentration of fecal coliform prior to disinfection: is ≤ 1,000 cfu per 100 mL, the CrT shall be 25 mg·min/L; is 1,000 to 10,000 cfu per 100 mL the CrT shall be 40 mg·min/L; and is ≥ 10,000 cfu per 100 mL the CrT shall be 120 mg·min/L.

[5] All discharges to groundwater for nonpotable reuse are regulated via a New Jersey Pollutant Discharge Elimination System Permit in accordance with N.J.A.C. 7:14A-1 et seq. and must comply with applicable Groundwater Quality Standards (N.J.A.C. 7:9C).

[6] In Virginia, groundwater recharge of a nonpotable aquifer may be regulated in accordance with regulations unrelated to the Water Reclamation and Reuse Regulation (9VAC25-740).

Table A-19. Indirect potable reuse (IPR) (Table 4-16 in USEPA 2012).

		Arizona [1]	California [2]	Florida [4]	Hawaii	Nevada	New Jersey [7]	North Carolina	Texas	Virginia [6]	Washington		
											Surface Percolation Class A	Direct Groundwater Recharge [8] Class A	Streamflow Augmentation Case-by-Case
Treatment (System Design) Requirements	Unit Processes	*NR*	Oxidized, coagulated, filtered, disinfected, multiple barriers for pathogen and organics removal	Secondary treatment, filtration, high-level disinfection, multiple barriers for pathogen and organics removal	Case-by-case	*ND*	*NR*	*NR*	Case-by-case	Case-by-case	Oxidized with nitrogen reduction, filtered, disinfected	Oxidized, coagulated, filtered, RO-treated, disinfected	Oxidized, clarified, disinfected
	UV dose, if UV disinfection used	*NR*	NWRI Guidelines[3]	NWRI UV Guidelines enforced, variance allowed	*NS*	*ND*	*NR*	*NR*	*NS*	*NS*	NWRI Guidelines	NWRI Guidelines	NWRI Guidelines
	Chlorine disinfection requirements., if used	*NR*	CrT > 450 mg•min/L; 90 minutes modal contact time at peak dry weather flow[3]	TRC > 1 mg/L; 15 minutes contact time at peak hr flow[5]	*NS*	*ND*	*NR*	*NR*	*NS*	*NS*	Chlorine residual > 1 mg/L; 30 minutes contact time at peak hr flow	Chlorine residual > 1 mg/L; 30 minutes contact time at peak hr flow	Chlorine residual to comply with NPDES permit
Monitored Reclaimed Water Quality Requirements	BOD_5 (or $CBOD_5$)	*NR*	*NS*	CBOD5: -20 mg/L (ann avg) -30 mg/L (mon avg) -45 mg/L (wk avg) -60 mg/L (max)	*NS*	*ND*	*NR*	*NR*	5 mg/L	*NS*	30 mg/L	5 mg/L	30 mg/L
	TSS	*NR*	*NS*	5 mg/L (max)	*NS*	*ND*	*NR*	*NR*	*NS*	*NS*	30 mg/L	5 mg/L	30 mg/L
Monitored Reclaimed Water Quality Requirements (cont'd)	Turbidity	*NR*	-2 NTU (avg) for media filters -10 NTU (max) for media filters -0.2 NTU (avg) for membrane filters -0.5 NTU (max) for membrane filters	Case-by-case (generally 2 to 2.5 NTU) Florida requires continuous on-line monitoring of turbidity as indicator for TSS	*NS*	*ND*	*NR*	*NR*	3 NTU	*NS*	-2 NTU (avg) -5 NTU (max)	-0.1 NTU (avg) -0.5 NTU (max)	*NS*

		Arizona [1]	California [2]	Florida [4]	Hawaii	Nevada	New Jersey[7]	North Carolina	Texas	Virginia [6]	Washington		
											Surface Percolation Class A	Direct Groundwater Recharge [8] Class A	Streamflow Augmentation Case-by-Case
	Bacterial Indicators	*NR*	Total coliform: -2.2/100mL (7-day med) -23/100mL (not more than one sample exceeds this value in 30 d) -240/100mL (max)	Total coliform: -4/100mL (max)	*NS*	*ND*	*NR*	*NR*	Fecal coliform or *E. coli* -20/100mL (30-d 65age) -75/100mL (max) *Enterococci* -4/100mL (30- d 65age) -9/100mL (max)	*NS*	Total coliform: -2.2/100 (7-d med) -23/100 (max)	Total coliform: -1/100mL (avg) -5/100mL (max)	Fecal coliform: -200/100mL (avg) -400/100mL (max wk)
	Total Nitrogen	*NR*	10 mg/l (avg of 4 consecutive samples)	10 mg/L (ann avg)	*NS*	*ND*	*NR*	*NR*	*NS*	*NS*	*NA*	10 mg/L	NPDES requirements to receiving stream
	TOC	*NR*	0.5 mg/L	-3 mg/L (mon avg) -5 mg/L (max); TOX[6]: < 0.2 (mon avg) or 0.3 mg/L (max); alternate limits allowed	*NS*	*ND*	*NR*	*NR*	*NS*	*NS*	*NA*	1 mg/L	*NS*
	Primary and Secondary Drinking Water Standards	*NR*	Compliance with most primary and secondary	Compliance with most primary and secondary	*NS*	*ND*	*NR*	*NR*	*NS*	*NS*	Compliance with SDWA MCLs	Compliance with most primary and secondary	NPDES requirements to receiving stream

		Arizona [1]	California [2]	Florida [4]	Hawaii	Nevada	New Jersey[7]	North Carolina	Texas	Virginia [6]	Washington		
											Surface Percolation Class A	Direct Groundwater Recharge [8] Class A	Streamflow Augmentation Case-by-Case
	Pathogens	*NR*	*TR*		*NS*	*ND*	*NR*	*NR*	*NS*	*NS*	*NS*	*NS*	*NS*

NS = not specified by the state's reuse regulation; NR = not regulated by the state under the reuse program; ND = regulations have not been developed for this type of reuse; TR = monitoring is not required but virus removal rates are prescribed by treatment requirements

[1] Arizona currently does not have IPR regulations; however, ADEQ regulates recharge facilities where mixed groundwater-reclaimed water may be recovered by a drinking water well through its Aquifer Protection Permit program (see Groundwater Recharge). The Governor's Blue Ribbon Panel on Water Sustainability issued a Report including a recommendation to develop a more robust regulatory/policy program to address IPR [US-AZ-Blue Ribbon Panel].

[2] These requirements are DRAFT and were taken from CDPH *Draft Regulations for Groundwater Replenishment with Recycled Water* (CDPH, 2011).

[3] Additional pathogen removal is required for groundwater recharge through other treatment processes in order to achieve 12 log enteric virus reduction, 10 log *Giardia* cyst reduction, and 10 log *Cryptosporidium* oocysts reduction.

[4] Florida requirements are for the planned use of reclaimed water to augment Class F-I, G-I or G-II groundwaters (US drinking water sources) with a background TDS of 3,000 mg/L or less. For G-II groundwaters greater than 3,000 mg/L TDS, the TOC and TOX limits do not apply. Florida also includes discharges to Class I surface waters (public water supplies) or discharges less than 24 hours travel time upstream from Class I surface waters as IPR. For discharge to Class I surface waters or water contiguous to or tributary to Class I waters (defined as a discharge located less than or equal to 4 hours travel time from the point of discharge to arrival at the boundary of the Class I water), secondary treatment with filtration, high-level disinfection, and any additional treatment required to meet TOC and applicable surface water quality limits is required. The reclaimed water must meet primary and secondary drinking water standards, except for asbestos, prior to discharge. The TOX limit does not apply and a total nitrogen limit is based on the surface water quality.
Outfalls for surface water discharges are not to be located within 500 feet (150 m) of existing or approved potable water intakes within Class I surface waters. Pathogen monitoring for Class I surface water augmentation is the same, except that if discharge is 24 to 48 hr travel time from domestic water supply*, Giardia, Cryptosporidium* sampling is once every 2 years.

[5] In Florida when chlorine disinfection is used, the product of the total chlorine residual and contact time (CrT) at peak hour flow is specified for three levels of fecal coliform as measured prior to disinfection. (See Section 6.4.3.1 for further discussion of CrT.) If the concentration of fecal coliform prior to disinfection: is ≤ 1,000 cfu per 100 mL, the CrT shall be 25 mg·min/L; is 1,000 to 10,000 cfu per 100 mL the CrT shall be 40 mg·min/L; and is ≥ 10,000 cfu per 100 mL the CrT shall be 120 mg·min/L.

[6] Total organic halides (TOX) are regulated in Florida.

[7] For groundwater recharge reuse is on a case-by-case basis, State Groundwater Quality Standards must be met.

[8] Washington requires the minimum horizontal separation distance between the point of direct recharge and point of withdrawal as a source of drinking water supply to be 2,000 feet (610 meters) and must be retained underground for a minimum of 12 months prior to being withdrawn as a drinking water supply.

APPENDIX B

WEBSITES FOR STATE REGULATIONS AND GUIDANCE ON WATER REUSE

The WateReuse Association will maintain links to the state regulatory sites containing water reuse regulations as links, and current regulations are subject to change by the states. Readers may access the state regulations link at https://www.watereuse.org/government-affairs/usepa-guidelines. (The following chart is reproduced from that site with links current in 2014.)

Alternate Link to State	Title of Regulations or Guidelines	Link to State Reuse Regulations or Guidance	Reuse Fact Sheet or Report
Alabama	Guidelines and Minimum Requirement for Municipal, Semi-Public and Private Land Treatment	http://adem.alabama.gov/alEnviroRegLaws/default.cnt	
Alaska	Alaska Administrative Code, Title 18 – Environmental Conservation, Chapter 72 – Wastewater Disposal	http://dec.alaska.gov/commish/regulations/pdfs/18%20AAC%2072.pdf	
Alaska - additional		http://dec.alaska.gov/water/wwdp/index.htm	
Arizona	Arizona Administrative Code – Title 18, Environmental Quality	http://www.azsos.gov/public_services/Title_18/18_table.htm	http://www.azdeq.gov/environ/water/permits/reclaimed.html
Arkansas	40 CFR 257, 40 CFR 503, and guidance from NRCS (for animal wastes)	http://www.adeq.state.ar.us/water/regulations.htm	
California	Title 22 California Code of Regulations	http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Lawbook.shtml	http://www.waterboards.ca.gov/water_issues/programs/grants_loans/water_recycling/directory.shtmlory.shtml
California – additional		http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/RecycledWater.shtml.	
Colorado	Water Quality Control Commission: Regulation No. 84 – Reclaimed Water Control Regulation (effective 9/30/07)	http://www.cdphe.state.co.us/regulations/wqccregs/	
Colorado – additional		http://www.cdphe.state.co.us/regulations/wqccregs/100284wqccreclaimed water.pdf	

Alternate Link to State	Title of Regulations or Guidelines	Link to State Reuse Regulations or Guidance	Reuse Fact Sheet or Report
Commonwealth of the Northern Mariana Islands	Commonwealth of the Northern Mariana Islands Wastewater Treatment and Disposal Rules and Regulations	http://www.marianasoperators.org/uploads/1/1/3/5/11353122/deq_ww_regs_book_2009.pdf	
Connecticut	No regulations or guidelines at this time	http://www.ct.gov/dep/cwp/view.asp?a=2709&q=324216&depNav_GID=1643	
Delaware		http://www.dnrec.delaware.gov/wr/Information/regulations/Pages/GroundWaterDischargesRegulations.aspx	
Delaware additional		http://www.dnrec.state.de.us/water2000/Sections/GroundWat/Library/ReclaimedWaterFactSheet.pdf	
District of Columbia	The District of Columbia currently does not have any regulations or guidelines addressing water reuse but considers projects on a case-by-case basis. The city is currently developing rules and water quality requirements for stormwater use.		
Florida	Chapter 62-610 of the Florida Administrative Code “Reuse of Reclaimed Water and Land Application; Section 403.064 of the Florida Statutes	http://www.dep.state.fl.us/water/reuse/apprules.htm	
Georgia	Guidelines for Water Reclamation and Urban Water Reuse; Georgia Guidelines for Reclaimed Water Systems for Buildings; Constructed Wetlands Municipal Wastewater Treatment Facilities Guidelines; Guidelines for Slow-Rate Land Treatment of Wastewater Via Spray Irrigation (LAS Guidelines)	http://epd.georgia.gov/watershed-protection-branch-technical-guidance	
Georgia - additional	Environmental Protection Division - Documents	http://www.gaepd.org/Documents/techguide_wpb.html	
Guam	Water Pollution Regulations	http://epa.guam.gov/rules-regs/regulations/water-pollution-regulations/	
Hawaii	State of Hawaii, Department of Health, Wastewater Branch	http://hawaii.gov/wastewater/pdf/reuse-final.pdf	

Alternate Link to State	Title of Regulations or Guidelines	Link to State Reuse Regulations or Guidance	Reuse Fact Sheet or Report
Hawaii - additional	Commission on Water Resource Management	http://hawaii.gov/dlnr/cwrm/planning_augmentation.htm	
Idaho	Idaho Administrative Code, Tittle 01, Chapter 17, IDAPA 58.01.17 – Recycled Water Rules	http://adminrules.idaho.gov/rules/current/58/0117.pdf	
Idaho – additional		http://adminrules.idaho.gov/rules/current/58/index.html	
Illinois	Title 35 Illinois Administrative Code Part 372 – Illinois Design Standards for Slow Rate Land Application of Treated Wastewater	http://www.ipcb.state.il.us/documents/dsweb/Get/Document-12046/	http://www.ilga.gov/legislation/ilcs/fulltext.asp?DocName=007023050K7
Indiana	Article 6.1 “Land application of Biosolid, Industrial Waste Product, and Pollutant- bearing Water” of Title 327 Water Pollution Control Board, Indiana Administrative Code.	http://www.in.gov/idem/4877.htm	http://www.in.gov/legislative/iac/title327.html
Iowa	Iowa Administrative Code Chapter 62: Effluent and Pretreatment Standards: Other Effluent Limits or Prohibitions	http://www.iowadnr.gov/InsideDNR/RegulatoryWater/NPDESWastewaterPermitting/NPDESRules.aspx	http://www.iowadnr.gov/portals/idnr/uploads/water/wastewater/dstandards/chapter21.pdf?amp;tabid=1316
Kansas		http://www.kdheks.gov/water/download/28_16.pdf	http://www.kwo.org/Kansas_Water_Plan/KWP_Docs/VolumeIII/LARK/Rpt_LARK_BPI_Role_Reuse_KWP2009.pdf
Kentucky	No regulations or guidelines at this time	Web address could not be located at time of publication.	
Louisiana	No regulations or guidelines at this time	Web address could not be located at time of publication.	
Maine	No regulations or guidelines at this time	Web address could not be located at time of publication.	
Maryland	Environment Article, Title 9, Subtitle 3; COMAR 26.08.01through 26.08.04 and 26.08.07.	http://www.mde.state.md.us/assets/document/MDE-WMA-001%20%28land-treatment%20Guidelines%29.pdf	http://www.mde.state.md.us/programs/Permits/WaterManagementPermits/Documents/www.mde.state.md.us/assets/document/permit/MDE-WMA-PER014.pdf

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Maryland – additional		http://www.mde.state.md.us/programs/Permits/WaterManagementPermits/WaterDischargePermitApplications/Pages/Permits/WaterManagementPermits/water_permits/index.aspx	
Massachusetts		http://www.mass.gov/dep/service/regulations/314cmr20.pdf	http://www.mass.gov/eea/agencies/massdep/water/
Michigan		Web address could not be located at time of publication.	
Minnesota		http://www.pca.state.mn.us/index.php/view-document.html?gid=13496	
Mississippi		Web address could not be located at time of publication.	
Missouri		http://www.sos.mo.gov/adrules/csr/current/10csr/10csr.asp#10-20	http://www.dnr.mo.gov/env/wpp/permits/index. html
Montana		http://deq.mt.gov/wqinfo/pws/docs/deq2%20revisions.pdf	
Nebraska	Title 119, Chapter 12 - Land Application of Domestic Effluent, Land Application of Single Pass Noncontact Cooling Water and Disposal of Domestic Biosolids	http://www.deq.state.ne.us/RuleAndR.nsf/pages/119-Ch-12	http://www.deq.state.ne.us/RuleandR.nsf/Pages/Rules
		http://www.deq.state.ne.us/RuleAndR.nsf/23e5e39594c064ee852564ae004fa010/97c32c5cd6c1802d8625674b006da528?OpenD	
		http://www.deq.state.ne.us/RuleAndR.nsf/23e5e39594c064ee852564ae004fa010/235cf139930e82d08625674b006e0738?OpenDocument	
		http://www.deq.state.ne.us/RuleAndR.nsf/23e5e39594c064ee852564ae004fa010/6fc9b4ab05f90c8e8625674b006fa9ab?OpenDocument	

Alternate Link to State	Title of Regulations or Guidelines	Link to State Reuse Regulations or Guidance	Reuse Fact Sheet or Report
Nevada	Nevada Administrative Code, Chapter445A, Sections 274 – 280; WTS-1A General design criteria for reclaimed water irrigation use; WTS-1B General design criteria for preparing an effluent management plan; WTS-3 Guidance Document For An Application For Rapid Infiltration Basins; WTS-7 Guidance Document for Reclaimed Water Storage Ponds	http://www.leg.state.nv.us/nac/nac-445a.html#NAC445ASec275	http://ndep.nv.gov/bwpc/fact01.htm
		http://ndep.nv.gov/admin/nrs.htm	
New Hampshire	No regulations or guidelines at this time	http://des.nh.gov/organization/commissioner/legal/rules/index.htm#water	
New Jersey		http://www.state.nj.us/dep/dwq/714a.htm	http://www.state.nj.us/dep/dwq/techmans/reuseman.pdf
New Mexico	NMED Ground Water Quality Bureau Guidance: Above Ground Use of Reclaimed Domestic Wastewater	http://www.nmenv.state.nm.us/gwb/documents/NMED_REUSE_1-24-07.pdf	http://www.rmwea.org/reuse/NewMexico.html
		http://www.nmenv.state.nm.us/gwb/NMED-GWQB-Regulations.htm	
New York		Web address could not be located at time of publication.	
North Carolina	15A North Carolina Administrative Code Subchapter 02U – Reclaimed Water	http://reports.oah.state.nc.us/ncac.asp?folderName=\Title%2015A%20-%20Environment%20and%20Natural%20Resources\Chapter%2002%20-%20Environmental%20Management	http://reports.oah.state.nc.us/ncac/title%2015a%20-%20environment%20and%20natural%20resources/chapter%2002%20-%20environmental%20management/subchapter%20u/subchapter%20u%20rules.html
North Dakota	Criteria for Irrigation with Treated Wastewater; Recommended Criteria for Land Disposal of Effluent	http://www.ndhealth.gov/WQ/	
Ohio		http://www.epa.state.oh.us/portals/35/rules/42-13.pdf	http://www.epa.state.oh.us/portals/35/rules/42-13_factsheet_feb08.pdf
		http://www.epa.state.oh.us/dsw/pti/index.aspx	

State	Title of Regulations or Guidelines	Link to State Reuse Regulations or Guidance	Alternate Link to Reuse Fact Sheet or Report
Oklahoma	OAC 252:656 "Water Pollution Control Construction Standards; OAC 252:627 Operation and Maintenance of Water Reuse; These regulations OAC 252:656 Subchapter 27 and OAC 252:627 are proposed.	http://www.deq.state.ok.us/rules/656.pdf	
		http://www.deq.state.ok.us/rules/627.pdf	
Oregon	Oregon Administrative Rules, Division 55 – Recycled Water Use	http://arcweb.sos.state.or.us/pages/rules/oars_300/oar_340/340_055.html	http://www.deq.state.or.us/wq/reuse/reuse.htm
Pennsylvania	Manual for Land Treatment of Wastewater; Reuse of Treated Wastewater Guidance Manual	http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-88575/385-2188-002.pdf	http://www.elibrary.dep.state.pa.us/dsweb/View/Collection-10105
Puerto Rico		Web address could not be located at time of publication.	
Rhode Island		http://www.dem.ri.gov/programs/benviron/water/permits/wtf/pdfs/reusegyd.pdf	
South Carolina	Section 67.300 of South Carolina Regulation 61-67, Standards for Wastewater Facility Construction "State Land Application Permit"	(Link given at WaterReUse.org is no longer valid)	
South Dakota		http://www.denr.sd.gov/des/sw/documents/DesignCriteriaManual.pdf.	
		http://legis.sd.gov/	
Tennessee		http://www.tn.gov/environment/permits/wqoperm.shtml	
		http://denr.sd.gov/des/sw/eforms/D0449V1-a_potw_appl.pdf	
Texas		http://www.tceq.texas.gov/rules/indxpdf.html#210	
US Virgin Islands		Web address could not be located at time of publication.	
Utah	Reuse requirements moved to UCA R317-3-11 (from UCA R317-1-2).	http://www.rules.utah.gov/publicat/code/r317/r317-001.htm#T4	http://www.rules.utah.gov/publicat/code/r317/r317-003.htm#T11

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Vermont	Environmental Protection Rules, Chapter 14, Indirect Discharge Rules	http://drinkingwater.vt.gov/poregionaloffices/rules.htm	
Virginia	Virginia Administrative Code Agency 25, Chapter 740 – Water Reclamation and Reuse Regulation	http://lis.virginia.gov/000/reg/TOC09025.HTM#C0740	
Washington	Chapter 90.46 Revised Code of Washington – Reclaimed water use	http://app.leg.wa.gov/rcw/default.aspx?cite=90.46&full=true	http://www.ecy.wa.gov/programs/wq/reclaim/index.html
West Virginia	Title 64 Series 47 Chapter 16-1 Sewage Treatment and Collection System Design Standards	http://apps.sos.wv.gov/adlaw/csr/ruleview.aspx?document=2802	
Wisconsin	Domestic Wastewater to Subsurface Soil Absorption Systems Permit (WI-0062901-2)	http://dnr.wi.gov/topic/wastewater/Permits.html	
Wyoming	Chapter 21 Water Quality Rules – Standards for the Reuse of Treated Wastewater	http://soswy.state.wy.us/Rules/RULES/2804.pdf	

APPENDIX C

REFERENCE AND ABBREVIATION LISTS

References

Bruursema, Tom. 2011. “The New NSF 350 and 350-1.” *Plumbing Systems and Design*, October 2011. http://www.nsf.org/newsroom_pdf/SU_PSD_Magazine_Article_LT_EN_350_351_LSU-2722-0911.pdf.

Harivandi, Ali. 2011. “Purple Gold – A Contemporary View of Recycled Water Irrigation.” USGA *Green Section Record* 49(45), Dec 16.

Scholze, Richard J. 2010. *Rainwater Harvesting for Army Installations*. Public Works Technical Bulletin 200-1-75. Washington, DC: Headquarters, USACE.

_____. 2011a. *Graywater Applications for Army Installations*. Public Works Technical Bulletin 200-1-101. Washington, DC: Headquarters, USACE.

_____. 2011b. *Implementing a Water Conservation Program on Army Installations*. Public Works Technical Bulletin 200-1-104. Washington, DC: Headquarters, USACE.

_____. 2011c. *Water Efficient Installations*. Public Works Technical Bulletin 200-1-105. Washington, DC: Headquarters, USACE.

_____. 2011d. “Water Reuse and Wastewater Recycling at U.S. Army Installations.” ERDC/CERL SR-11-7. Champaign, IL: US Army Engineer Research and Development Center, Construction Engineering Research Laboratory.

USEPA. 2004. *2004 Guidelines for Water Reuse*. EPA/625/R-04/108. Washington, DC: USEPA Municipal Support Division, Office of Wastewater Management, Office of Water and Cincinnati, OH: USEPA Technology Transfer and Support Division, National Risk Management Research Laboratory, Office of Research and Development. Available at http://water.epa.gov/aboutow/owm/upload/Water-Reuse-Guidelines-625r04108.pdf.

_____. 2012. *2012 Guidelines for Water Reuse*. Produced by CDM Smith under a Cooperative Research and Development Agreement with the USEPA. EPA/600/R-12/618. Washington, DC: USEPA Office of Water and Office of Research and Development; US Agency for International Development. Available at: http://nepis.epa.gov/Adobe/PDF/P100FS7K.pdf.

WateReuse Association. 2009. *Manual of Practice on How to Develop a Water Reuse Program*. Alexandria, VA: WateReuse Association.

Resources

National Academy of Sciences. 2013. *Water Reuse: Potential for Expanding the Nation's Water Supply through Reuse of Municipal Wastewater*. Washington, DC: The National Academies Press. Information at: http://www.nap.edu/openbook.php?record_id=13303.

World Health Organization. 2006. "WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater; Volume 4: Excreta and Greywater Use in Agriculture. Geneva, Switzerland: WHO. Available for download at http://www.who.int/water_sanitation_health/wastewater/gsuweg4/en/

Leverenz, Harold L., George Tchobanoglous, and Takashi Asano. 2011. "Direct Potable Reuse: A Future Imperative." *Journal of Water Reuse and Desalination* 01(1): 2–10. doi:10.2166/wrd.2011.000.

Abbreviations

Abbreviation	Spelled Out
AEWMP	Army Energy and Water Management Program
ANSI	American National Standards Institute
AR	Army Regulation
ASA (IE&E)	Assistant Secretary of the Army Installations, Energy and Environment
ASR	Aquifer Storage and Recovery
BOD	biochemical oxygen demand
$CBOD_5$	carbonaceous biochemical oxygen demand
CECW	Directorate of Civil Works, US Army Corps of Engineers
CEMP	Directorate of Military Programs, US Army Corps of Engineers
CERL	Construction Engineering Research Laboratory
CFR	Code of the Federal Regulations
CNMI	Commonwealth of the Northern Mariana Islands
CONUS	Continental United States
CVWF	central vehicle wash facility
CWA	Clean Water Act
DPR	direct potable reuse
dS/m	deciSiemens per meter
ECw	electrical conductivity
EO	Executive Order
ESA	Endangered Species Act
ERDC	Engineer Research and Development Center

Abbreviation	Spelled Out
HQUSACE	Headquarters, US Army Corps of Engineers
IPC	International Plumbing Code
IPR	indirect potable reuse
MCL	maximum contaminant level
meq/L	milli equivilants per liter
mg/L	milligrams per liter
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NSF	NSF International (formerly National Sanitation Foundation)
NTU	nephelometric turbidity unit
OCONUS	outside Continental United States
PL	public law
POC	point of contact
PWTB	Public Works Technical Bulletin
SAR	sodium adsorption ratio
SDWA	Safe Drinking Water Act
TOC	total organic carbon
TSS	total suspended solids
UIC	underground injection control
UPC	Uniform Plumbing Code
USACE	US Army Corps of Engineers
USEPA	US Environmental Protection Agency; also EPA
U.S.C.	United States Code