Draft Discussion Framework for a Water Reuse Action Plan

I. Vision

Water reuse can be a valuable means to enhance the availability and effective use of our Nation's water resources and should be considered as part of an integrated water resources management approach developed at the basin or watershed level to meet multiple needs. An integrated approach commonly involves a combination of water management strategies (e.g., water supply development, water storage, water use efficiency, and water reuse) and engages multiple stakeholders and needs, including the needs of the environment. EPA, in collaboration with other Federal Agencies, states, tribes, locales, the water sector, and other partners and stakeholders, will work to enhance consideration and application of water reuse through development and implementation of a Water Re-use Action Plan.

For purposes of this discussion framework, "water reuse" includes other common terminology including recycled water, reclaimed water, alternative water supplies, improved water reliability, and water resource recovery.

This draft Discussion Framework is intended to inform the development of a Water Reuse Action Plan to support actions that help make water available that is otherwise unavailable today, while protecting public health and the environment. EPA will leverage and continue to engage with other Federal agencies, industry, agriculture, water utilities, and others with keen water interests. EPA will also be a key partner to implement the Water Security Grand Challenge with the U.S. Department of Energy (DOE), which has key elements related to water reuse:

> *"The Water Security Grand Challenge will incentivize new technologies aimed at solving one of the most important global challenges of our time – providing access to clean, safe, and secure water. EPA looks forward to partnering with DOE to help bring clean and safe water to communities across the country and find innovative ways to transform non-traditional water sources into resources."* – EPA Acting Administrator Andrew Wheeler, October 25, 2018.

II. Business Case - Impetus for Action

The Nation's water resources are the lifeblood of our communities, supporting our economy and way of life. Across the country, we depend upon reliable sources of clean and safe water.[1] Though water reuse is a well-established practice in certain areas, substantial opportunities exist to optimize its consideration and application for many different purposes across the country. For example, forty out of fifty State water managers expect to face freshwater shortages in their states in the next ten years.[2]

Multiple federal agencies maintain initiatives that address water reuse (see Section IV), but they are not always coordinated or leveraged to maximize benefits. Progress could be made more impactful with a unified, crosscutting strategy and action plan. Congress, multiple states, and stakeholders have increasingly called for action and focus on water reuse, which could be bolstered by federal, state, and watershed-based collaboration, when desired and appropriate.

The literature identifies many motivations for consideration of water reuse as part of a diverse portfolio of water sources to meet current and future water demands, including:

- accommodating population growth and urbanization;
- substituting reclaimed water for applications that do not require drinking-quality water:
- protecting aquatic ecosystems through avoiding of freshwater withdrawals/diversions;
- groundwater overdrafts and related impacts (land subsidence and saltwater intrusion);
- lower energy costs for treatment and transportation of water;
- controlling or mitigating saltwater intrusion and land subsidence;
- creating water alternatives in response to prolonged and severe droughts;
- enhancing water security through portfolio diversification and resilience;

[1] EPA Strategic Plan, FY 2018-2022, February 12, 2018
[2] Government Accountability Office (GAO) 2014. Freshwater: Supply Concerns Continue and Uncertainties Complicate Planning. GAO-14-430

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- augmenting existing water sources to enable long term economic and environmental sustainability; and
- promoting coordinated and integrated water resources management.

III. Use Cases - Examples of Types and Fit-for-Purpose Applications of Water Reuse and Alternative Water Sources

The Table below identifies the broad categories of water reuse applications and a brief summary of examples of challenges for reuse. The table is followed by very brief illustrative examples of current water reuse practices that help to demonstrate applications and opportunities for fuller consideration of water reuse.

Category	Use Application	Challenges for Implementers
Ag & Irrigation	Urban lands/green infrastructure and fixtures	Dual Distribution costs; Seasonal demand; salinity; cross connection control; state variability in food irrigation water quality standards
	Agriculture (plant/tile drains)	
	Livestock	
As a Drinking Water Source	Direct Potable	Energy intensive; state preclusions; public support; lack of cohesive risk-based standards; infrastructure limitations; broad acceptance of treatment capabilities
	Indirect Potable / Augmentation	
	Aquifer Storage and Recovery	
Non-potable onsite reuse	Rainwater harvesting	Prior appropriation, local constraints, lack of data on quality
	A/C condensate	Inefficiency; Monitoring data
	Atmospheric water generation/ biomass gasification	Inefficiency; monitoring data
	Building-scale	Cost effective treatment technologies, risk assessments re: fit-for-purpose reuse, appropriate safety indicators; varied regulations across the states
Nat'l Security and Military	Military Ops	Energy and water intensive
	U.S. Disaster Response	Energy intensity; uncertainty in treatment needs; equity concerns
Impoundments	Rec/Landscape Impoundments	Nutrient removal needs; ecological risks; dual systems
	Snowmaking	Sometimes a non-point discharge; site ecology; public support
Environmental	Wetlands	Species sensitivity and site-specific requirements; nutrient removal needs
	Protection from Salt Water Intrusion	
	Stream flow augmentation	
	Groundwater/Aquifer Recharge	Site hydrogeology; aquifer degradation; advanced treatment needs
	Source Water Protection	Numerous
Industrial (onsite, imported)	Cooling (effluent reuse, stormwater capture)	Fit-for-use treatment variability; dual distribution; cost of alternative wastewater management methods
	Boiler Water	
	Produced Water (Oil & Gas, other Energy); process water	
	Manufacturing	

Following are illustrative examples of opportunities and examples of water reuse for some of the use applications in the Table above:

Agriculture and Irrigation – Indications of use of wastewater for agricultural irrigation extends back about 3000 years to ancient Greece. In 1929 the City of Pomona, CA, initiated use of reclaimed water for lawn and garden irrigation. By 2002, nearly half of all reclaimed water produced in California was used for agricultural irrigation. The Monterey Regional Water Pollution Control Facility began delivering 20 million gallons per day (mgd) of recycled water for food crop irrigation in 1998, and today, Monterey One Water recycles approximately 4 billion gallons a year for crop irrigation.

> *"The United States uses 587.76 million gallons of recycled water per day for agricultural irrigation, and this number is on an upward trend."*
>
> -- CONSERVE website

Direct Potable Reuse (DPR) – The first demonstrated practice of DPR began in Namibia in 1968 and continues today. The first example of DPR in the U.S. may have taken place in Chanute, KS, in 1956-1957 when the Neosho River ceased to flow the city reused its treated sewage for 5 months, recirculating it some eight to fifteen times. In 2013, both spurred by drought, Wichita Falls and Big Spring, TX, received approval from the Texas Commission on Environmental Quality to implement direct potable use programs. Wichita Falls suspended its DPR operations in 2015 with easing of the drought impacts. The Big Spring DPR program continues. El Paso, TX, launched a pilot

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facility in 2015 to create water suitable for potable reuse; its future full-scale facility will produce 10 mgd, helping to serve 36,000 homes.

Indirect Potable Reuse (IPR) – The Occoquan Sewage Authority (UOSA) in Northern Virginia is a commonly cited example of a planned IPR since 1978. UOSA's advanced water reclamation facility discharges about 50 mgd to the public water supply, Occoquan Reservoir. The reclaimed water represents as little as 10% or as much as 90% of the reservoir inflow, depending on rainfall – drought conditions. While UOSA is an example of planned IPR, unplanned or "de facto" IPR is very common across the U.S.

Groundwater Replenishment – In California, Orange County Water District's "Water Factory 21" began groundwater injection of reclaimed water in 1975. Today, OCWD injects 100 mgd into the aquifer to replenish drinking water production wells and prevent saltwater intrusion.

Industrial Reuse – Opportunities for industrial applications of reclaimed water include: cooling water, boiler water, process, water, and other needs. In 1995, 0.4% of U.S. manufacturing water needs were met with reclaimed water while 60% came from surface water and 17% from public water supplies. The Bethlehem Steel Company in Baltimore, MD, used chlorinated wastewater effluent for steel processing from 1942 through the 1990s. West Basin Water District (Los Angeles, CA) produces "designer water" from its wastewater to meet the specific quality needs for various industrial and commercial customers (e.g., cooling tower water, boiler feed water, irrigation)

Environmental Restoration – Phoenix, AZ, uses treated wastewater to restore and maintain 500 acres of vital wetland and riparian habitat in the Salt River bottomlands.

> *"The need to secure future water supplies, in the face of increasing demand and uncertain water availability, is driving adoption of water reuse. Bluefield Research forecasts municipal water reuse systems will reach over US$21.5 billion between 2017 and 2027, including more than 775 projects in the development pipeline across 19 states. At the epicenter are three states – California, Texas, and Florida – which represent 80 percent of planned capacity additions."*
>
> -- Bluefield Research

IV. Examples of Particularly Relevant Efforts

Federal

- *Presidential Memo: Promoting the Reliable Supply and Delivery of Water in the West* (10/19/18) "directs for federal investment in technology and reduction of regulatory burdens to enable broader scale use of recycled water; and programs that promote and encourage innovation, R&D of technology that improve water management, using best available science through real-time monitoring of wildlife and water deliveries."
- *Water Security Grand Challenge* announced by Secretary Perry (10/25/18) has at least two challenge goals that specifically involve opportunities for water reuse: energy produced water and municipal wastewater.
- Water Infrastructure Improvements for the Nation Act (Public Law 114-322) amended the Water Infrastructure Finance and Innovation Act (WIFIA) to include explicit eligibility for "a water recycling project or a project to provide alternative water supplies to reduce aquifer depletion" (Section 5008 of WIIN).
- America's Water Infrastructure Act of 2018 specifies Congress' intent that water reuse is a key part of the National water infrastructure:
  - *S.2004* – Sense of Congress that nonpotable sources for industry can relieve supply/demand challenges. Encourages implementing and incentivizing nonpotable reuse to achieve water savings and conservation needs.
  - *S.2007* - Authorizes $10m in FY19/20; requires new grant program to accelerate R&D and technology deployment.
  - *S.2017* - Requires EPA to comprehensively review drinking water treatment technologies and disseminate results.
  - *S.4102* - Requires EPA to disseminate information on cost-effective and alternative technologies, and Report to Congress within one year, and tri-annually thereafter, on alternative wastewater treatment and recycling tech.

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- Federal Technology Transfer Authority (15 USC 3710a) and Federal Prize Competition Authority (15 USC 3719) authorizes federal agencies to collaborate on research and development and related efforts.
- *National Drought Resilience Partnership (NDRP),* established by Presidential Memorandum (2016), coordinates efforts among agencies to assist in building long-term drought resilience in basins and regions.
- *U.S. Government Global Water Strategy* (2017) outlines the Federal Family's global approach to fostering a water-secure world, describing each Agency's roles therein – such as Bureau of Reclamation's charge to foster water reuse and recycling.

EPA

- EPA Reuse Guidelines (5): 2017 Potable Reuse Compendium and Guidelines for Water Reuse (2012, 2004, 1992 and 1980).
- Office of Water Study of Oil and Gas Extraction Wastewater Management to solicit perspectives on, and consider management approaches, in unconventional and conventional O&G wastewater management.
- Office of Water Microbial Risk Assessments related to Potable Reuse (see "Nappier et al." in Literature Reviewed section).
- EPA-New Mexico MOU to clarify existing regulatory and permitting frameworks related to the way produced water from oil and gas extraction activities can be reused, recycled, and renewed for other purposes. EPA and New Mexico developed a draft white paper, "Oil and Natural Gas Produced Water Governance in the State of New Mexico," released November 9, 2019.

Water Sector and Other Stakeholders

- Numerous utilities, communities, and industries announcing initiatives, completing projects, or maintaining infrastructure to reuse of their water resources.
- *The Water Reuse Roadmap,* Water Environment Federation 2018
- *Making the Utility Case for Onsite Non-potable Water Systems,* National Blue-Ribbon Commission for Onsite Non-potable Water Systems, U.S Water Alliance and Water Research Foundation, 2018.
- *Mainstreaming Potable Water Reuse in the United States,* ReNUWIt, Johnson Foundation and EPA, 2018.
- *Potable Reuse: Guidance for Producing Safe Drinking Water,* World Health Organization, 2017.
- *A Guidebook for Developing and Implementing Regulations for Onsite Non-potable Water Systems,* U.S Water Alliance and Water Research Foundation, 2017.
- *Toward Global Water Security,* Peter Engelke and David Michel, Atlantic Council, 2016.
- *Potable Reuse Research Compilation,* WE&RF and National Water Research Institute (NWRI), 2016.
- *Framework for Direct Potable Reuse,* AWWA, WateReuse, WEF, NWRI, 2015.
- *Addressing Water Scarcity Through Recycling and Reuse: A Menu for Policymakers,* GE Ecomagination, 2015.
- *Health Guidelines for the Use of Wastewater in Agriculture and Aquaculture,* World Health Organization, 1989.

V. Potential Framework of a National Water Reuse Action Plan

Components of a Water Reuse Action Plan may include the actions of many water stakeholders and address several thematic areas, including: 1) technological improvements, 2) regulatory/policy aspects, 3) financial initiatives; 4) fit for purpose, 5) water information use and availability, and 6) public outreach. Each type of reuse could be evaluated with these five components to inform a greater understanding of the incentives for and barriers to water reuse. Below are examples of high-level actions and/or information gaps under each of the five components. EPA will engage stakeholders and brainstorm action items which may inform specific activities and refine the high-level actions and information gaps which guide work towards framing of a water reuse strategy and action plan. Actions could be taken by a variety of different water stakeholders or groups of collaborative interests.

I. Technological Improvements

a. Technology Development, Piloting, Validation – Identifying technological needs; evaluating applications, efficacy, and limitations of existing technologies; and fostering opportunities for pilot

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testing to assist regulators and drive costs and feasibility towards "pipe parity" (e.g., closer or equal to other water supplies).

b. Monitoring and Sensors – Collecting timely, robust, quality data to verify that water is safe and meets quality expectations, namely online and offline standardized methods to understand reuse water needs and fit for purpose baselines (for example, biological risks and operations for potable reuse, or dissolved mineral content for niche manufacturing).

c. Data Sharing and Integration – Creating the mechanisms for water information to be shared and integrated and usable at the different scales of water supply needs and uses to facilitate water reuse consideration.

d. Concentrate and Brine Management – Determining the management and reclamation opportunities for managing brines/concentrates is often problematic with limited current viable disposal method in some areas.

e. Research Coordination and Critical Gaps – Despite decades of research across the Federal and private sector, there may be critical remaining needs to be addressed.

II. Regulatory/Policy Aspects at All Levels of Government

a. Public Health Protection – Exploring establishment of critical public health benchmarks and guidelines and risk-based baselines (e.g., pathogen removal targets and other risk-based constituent removal targets) to advance the practice – particularly in types of reuse which lack guidelines/regulatory frameworks – and continuing development and utilization of tools and processes for locales and water managers to evaluate public health risks and ensure any reused water is fit for purpose.

b. Regulatory and Policy Incentives, Barriers, and Facilitation – Creating an environment where reuse can be realistically and routinely considered within a unified framework.

c. Workforce and Operator Training Certification Programs – Fostering a workforce with training and skills to operate complex technologies, and Manuals of Practice and Procurement to support operators and administrators alike.

d. Addressing Other Institutional Barriers

III. Financial Initiatives

a. Financing and Funding Eligibility – Ensuring Federal / State funding eligibility is clear, can be easily integrated, and fosters reuse projects.

IV. Fit for Purpose

a. Water Quality Performance Requirements to Assure that Recycled Water Meets Use and User Needs – Helping states and other entities determine levels of treatment for recycled water depending on intended use (i.e., including potable; ecosystems; groundwater; irrigation/agriculture; boiler/cooling water; etc.) and technical/infrastructure specifications.

V. Information about Water Use and Availability

a. Facilitating the sharing of information about water use and availability

b. Encouraging watershed-based water information hubs and collaboratives to optimize sharing and integration of water information to foster use and protection of water resources.

VI. Outreach Opportunities

a. Public Outreach – Understanding the importance of public acceptance of reused water, and ensuring clear, consistent messaging and risk communication from the federal family on basic questions related to reuse. Articulating lessons learned.

b. Communication – Facilitating the deployment and dissemination of critical and relevant water reuse-related information.

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VI. Example Collaborators and Potential Contributors to a Water Reuse Action Plan

Federal Partners on Water

- EPA: OW, ORD, OP, OECA, OMS, OSRTI, Regions 1–10
- Department of Agriculture (USDA) (e.g., NIFA, ERS, ARS, NRCS)
- Department of Interior (DOI) (e.g., BLM, BoR, USGS)
- Department of Commerce (National Oceanic & Atmospheric Administration (NOAA))
- Department of Energy (DOE)
- Army Corps of Engineers

Other Federal Agencies and Working Groups

- Department of Defense (DoD)
- National Science Foundation (NSF)
- National Research Council
- National Academies of Science, Engineering and Medicine
- Department of State (DOS)
- National Aeronautics and Space Administration (NASA)
- Centers for Disease Control (CDC)
- Food and Drug Administration (FDA)
- White House Office of Science & Technology Policy (OSTP)
- US Agency for International Development (USAID)
- Water Treatment Interagency Working Group (WaTr)

States

- Association of Clean Water Administrators (ACWA)
- Association of State Drinking Water Administrators (ASDWA)
- Specific States (e.g., Virginia; Texas; Georgia; Alaska; California; Florida; Colorado River Basin States)
- Western States Water Council (WSWC)
- Environmental Council of the States (ECOS)/ITRC
- National Governors Association

NGOs

- WateReuse Association
- Water Environment Federation (WEF)
- American Water Works Association (AWWA)
- The Water Research Foundation (TWRF)
- National Water Research Institute (NWRI)
- National Association of Clean Water Agencies (NACWA)
- National Rural Water Association (NRWA)
- US Water Alliance
- Alliance for Water Efficiency
- Environmental Advocacy (e.g., NRDC, EDF)
- Pacific Institute
- Rural Community Assistance Project (RCAP)

Water Sector/Utilities/Regional Partnerships/Locales

- National Blue Ribbon Commission on Onsite Non-potable Water Systems
- Water Utilities (e.g., OCWD, SFPUC, El Paso, HRSD)
- Water Hubs and Technology Innovation Clusters
- Western Resource Advocates

Agriculture, Industry, Energy and Environmental Groups And Academia

- University of Arizona - Tucson
- Re-Inventing the Nation's Urban Water Infrastructure (ReNUWIt)
- Stanford Woods Institute/Water in the West
- Center of Excellence at the Nexus of Sustainable Water Reuse, Food and Health, UMD
- Natural Resources Defense Council
- The Nature Conservancy

VII. EPA Water Reuse Team

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OGC (tbd)

VIII. Questions for Development of the Plan

- What is the proper scope for a Water Reuse Action Plan? Are key elements missing?
- By your vantage, what are the specific actions – big and small – that could be taken to best achieve the water reuse vision, both broadly and in a particular use application or scenario?
- What are the most valuable actions the Federal Family, States and the water sector and stakeholders can undertake to advance consideration of water reuse as part of an integrated water resources approach?

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- Do the thematic areas listed in Section V resonate with existing roadmaps, plans, and real needs?
- What are the unique value-adds that public agencies/regulators at any level can bring to table?
- How can this effort be rolled out to ensure all who need to be involved are able to participate?
- In the near term, what are the critical venues (conferences, events, meetings, etc.) where ideas on reuse could be discussed and refined?

IX. Upcoming Water Reuse and Related Forums

Existing meetings and forums represent opportunities to gain insights:

- NACWA Winter Meeting, Albuquerque, NM, Feb. 5-8, 2019
- Resource Revolution of Water Reuse (Wharton, IGEL, Suez), San Francisco, February 27, 2019
- Membrane Tech Conference, New Orleans, Feb. 25-28, 2019
- Utility Management Conference, Nashville, TN, March 5-8, 2019
- 2019 WateReuse California Annual Conference, Orange County, CA, March 17-19
- ACWA Mid-Year Meeting, Alexandria, VA, March 19-20, 2019
- ASDWA Member Meeting 2019, Alexandria, VA, March 25-27, 2019
- Sustainable Water Management Conference, Tucson, AZ, March 31-April 3, 2019
- National Water Week/Water Policy Fly In, Washington, DC, March 31-April 1, 2019
- AWWA Annual Conference and Expo, Denver, CO, June 9-12
- International Water Association Annual Conference, Berlin, June 2019
- ASDWA/EPA Data Management Users Conference, Atlanta, GA, July 22-25
- ACWA Annual Meeting, Austin, TX, Aug. 27-29, 2019
- 34th Annual WateReuse Symposium, San Diego, CA, Sept. 8-11, 2019
- WEFTEC, Chicago, Oct. 2019
- Water Quality Technology Conference, Dallas, TX, Nov. 2019
- Others?

X. Published Literature Reviewed

Absar, Mariya et al. n.d. *Life Cycle and Cost Assessments of Atmospheric Water Generation Technologies and Alternative Potable Water Emergency Response Options.* Under clearance. ORD-028439.: EPA/600/X-18/331.

American Water Works Association. 2016. *Potable Reuse 101: An Innovative and Sustainable Water Supply Solution.*

Arden, Sam, and Mark Brown. Xin (Cissy) Ma. 2018. "Energy Analysis of Constructed Wetland for Greywater Recycle and Reuse." *Sciene of the Total Environment (630)* 587-599. ORD-024459.

Cashman, Sarah et al. July 2017. "Holistic evaluation of decentralized water reuse: life cycle assessment and cost analysis of membrane bioreactor systems in water reuse implementation." *International Water Association.*

Cashman, Sarah et al. 2018. "Energy and greenhouse gas life cycle assessment and cost analysis of aerobic and anaerobic membrane bioreactor systems: Influence of scale, population density, climate, and methane recovery." *Bioresource Technology (254)* 56-66. ORD-018382.

Cashman, Sarah et al. 2016. *Life Cycle Assessment and Cost Analysis of Water and Wastewater Treatment Options for Sustainability: Influence of Scale on Membrane Bioreactor Systems.* Environmental Protection Agency. EPA/600/R-16/243. ORD-019901.

Environmental Protection Agency. 2012. *2012 Guidelines for Water Reuse.* EPA/600/R-12/618. https://www3.epa.gov/region1/npdes/merrimackstation/pdfs/ar/AR-1530.pdf.

Environmental Protection Agency. 2018. *2017 Potable Reuse Compendium.* EPA/810/R-17/002. https://www.epa.gov/sites/production/files/2018-01/documents/potablereusecompendium_3.pdf.

—. 2018. "FY 2018-2022 U.S. EPA Strategic Plan." February. https://www.epa.gov/sites/production/files/2018-02/documents/fy-2018-2022-epa-strategic-plan.pdf.

—. 2018. "National Water Program Guidance FY 2018-2019." 800D17001. https://www.epa.gov/sites/production/files/2017-09/documents/fy18-19-ow-npm-guidance.pdf.

—. 2015. "Safe and Sustainable Water Resources Strategic Research Action Plan 2016-2019." November. EPA 601/K-15/004. https://www.epa.gov/sites/production/files/2015-10/documents/strap_2016_sswr_508.pdf.

Environmental Protection Agency, Reinventing the Nation's Urban Water Infrastructure (ReNUWIt), and the Johnson Foundation at Wingspread. 2018. "Mainstreaming Potable Water Reuse in the United States: Strategies for Leveling the Playing Field." April. https://www.epa.gov/sites/production/files/2018-04/documents/mainstreaming_potable_water_reuse_april_2018_final_for_web.pdf.

Freedman, Jon, C. Enssle. 2015. Addressing Water Scarcity Through Recycling and Reuse: A Menu for Policymakers.

Harris-Lovett, S.R. et al. 2015. "Beyond User Acceptance: A Legitimacy Framework for Potable Water Reuse in California." *Environmental Science and Technology (49)* 7552-7561. doi:10.1021/acs.est.5b00504.

Harris-Lovett, Sasha, Judit Lienert, and David L. Sedlak. 2018. "Towards a New Paradigm of Urban Water Infrastructure: Identifying Goals and Strate-gies to Support Multi-Benefit Municipal Wastewater Treatment." *Water 10(9)* 1127. https://doi.org/10.3390/w10091127.

Jahne, Michael A. et al. 2017. "Simulation of enteric pathogen concentrations in locally-collected greywater and wastewater for microbial risk assessments." *Microbial Risk Analysis (5)* 44-52. doi:https://doi.org/10.1016/j.mran.2016.11.001.

Medina, Victor F., Richard J. Scholze, Scott A. Waisner, and Chris S. Griggs. 2015. "Energy and Resource Recovery from Wastewater Treatment: State of the Art and Potential Application for the Army and DOD." US Army Corps of Engineers, Engineer Research and Development Center (ERDC). https://apps.dtic.mil/dtic/tr/fulltext/u2/a619808.pdf.

Metcalf & Eddy. 2007. *Water Reuse: Issues, Technologies and Applications.*Published by McGraw Hill.

Morelli, Ben et al. n.d. *Life Cycle Assessment and Cost Analysis of Distributed Mixed Wastewater and Graywater Treatment for Water Recycling in the Context of an Urban Case Study.* EPA report: EPA/600/X-18/280. Under clearance. ORD-028027.

Nappier, S.P., J.A. Soller, and S. Eftim. 2018. "Potable Water Reuse: What Are the Microbiological Risks?" *Current Environmental Health Reports 5(2)* 283-292. doi:10.1007/s40572-018-0195-y.

National Academies of Sciences, Engineering and Medicine. 2018. *Future Water Priorities for the Nation: Directions for the U.S. Geological Survey Mission Area.* Washington, District of Columbia: National Academies Press. http://nap.edu/25134.

National Research Council. 2012. *Understanding Water Reuse: Potential for Expanding the Nation's Water Supply Through Reuse of Municipal Wastewater.* Washington, DC: The National Academies Press. doi:https://doi.org/10.17226/13514.

Schoen, ME, and J Garland. 2017. "Review of pathogen treatment reductions for onsite non-potable reuse of alternative source waters." *Microbial Risk Analysis* 25-31. doi:https://doi.org/10.1016/j.mran.2015.10.001.

Schoen, ME, MA Jahne, and JL Garland. 2018. "Human Health Impact of Cross-Connections in Non-Potable Reuse Systems." *Water 10(10)* 1352. doi:doi:10.3390/w10101352 .

Schoen, ME, NJ Ashbolt, MA Johne, and JL Garland. 2017. "Risk-Based Enteric Pathogen Reduction Targets for Non-Potable and Direct Potable Use of Roof Runoff, Stormwater, and Greywater." *Microbial Risk Analysis* 32-43. doi:https://doi.org/10.1016/j.mran.2017.01.002.

Sedlak, David. 2015. *Water 4.0.* Yale University Press.

Soller, JA et al. 2017. "Evaluation of microbiological risks associated with direct potable reuse." *Microbial Risk Analysis* 3-14. doi:https://doi.org/10.1016/j.mran.2016.08.003.

Soller, JA, SE Eftim, and SP Nappier. 2018. "Direct potable reuse microbial risk assessment methodology: Sensitivity analysis and application to State log credit allocations." *Water Research 128(1)* 286-292. doi:10.1016/j.watres.2017.10.034.

Tasker, TL et al. 2018. "Environmental and Human Health Impacts of Spreading oil and Gas Wastewater on Roads." *Environmental Science and Technology 52(12)* 7081-7091. doi:10.1021/acs.est.8b00716.

The Water Research Foundation. 2017. "Blueprint for One Water." http://www.waterrf.org/PublicReportLibrary/4660.pdf.

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The Water Research Foundation. 2019. *Agricultural Use of Recycled Water: Impediments and Incentives.*
United States Department of Energy, Department of Interior, and Environmental Protection Agency. 2014. "Federal Multiagency Collaboration on Unconventional Oil and Gas Research: A Strategy for Research and Development." July 18. https://www.energy.gov/sites/prod/files/2017/04/f34/Multiagency_UOG_Research_Strategy.pdf.
United States Government Accountability Office. 2014. "Freshwater: Supply Concerns Continue, and Uncertainties Complicate Planning." GAO-14-430. https://www.gao.gov/assets/670/663343.pdf.
US Bureau of Reclamation. 2016. "WaterSMART Progress Report 2010-2016." December. https://www.usbr.gov/watersmart/docs/2016/2016watersmartprogressreport.pdf.
US Department of Agriculture Agricuture Research Service. 2016. "Water Availability and Watershed Management Action Plan 2016-2020." *National Program 211: Water Availability and Watershed Management.* https://www.ars.usda.gov/natural-resources-and-sustainable-agricultural-systems/water-availability-and-watershed-management/docs/action-plans/.
US Department of Agriculture. 2017. "Report to the President of the United States from the Task Force on Agriculture and Rural Prosperity." *Task Force on Agriculture and Rural Prosperity.* October 21. https://www.usda.gov/sites/default/files/documents/rural-prosperity-report.pdf.
US Department of State and US Agency for International Development. 2017. "US Government Global Water Strategy." https://www.state.gov/documents/organization/275842.pdf.
US Water Alliance and Water Research Foundation. 2017. "A Guidebook for Developing and Implementing Regulations for Onsite Non-potable Water Systems." *National Blue Ribbon Commission for Onsite Non-potable Water Systems.* http://uswateralliance.org/sites/uswateralliance.org/files/publications/NBRC%20GUIDEBOOK%20FOR%20DEVELOPING%20ONWS%20REGULATIONS.pdf.
US Water Alliance. 2017. "One Water for America Policy Framework." http://uswateralliance.org/sites/uswateralliance.org/files/publications/One%20Water%20for%20America%20Policy%20Framework%20Executive%20Summary.pdf.
—. n.d. "Resources for Onsite Non-potable Water Programs." *National Blue Ribbon Commission for Onsite Non-potable Water Systems.* http://uswateralliance.org/initiatives/commission/resources.
Water Environment Federation. 2018. *Water Reuse Roadmap.* Alexandria: Water Environment Federation.
Water Research Foundation. 2017. "Potable Reuse Research Compilation: Synthesis of Findings." http://www.waterrf.org/Pages/Projects.aspx?PID=4645.
WateReuse Association. 2018. "Proceedings of the 33rd Annual WateReuse Symposium, September 9-12, 2018."
—. 2014. "The Opportunities and Economics of Direct Potable Reuse." https://watereuse.org/watereuse-research/the-opportunities-and-economics-of-direct-potable-reuse/.
—. n.d. "Water Reuse: Transforming Water, Sustaining Our Future." https://watereuse.org/wp-content/uploads/2018/04/Water-Reuse-Transforming-Water-Sustaining-Our-Future.pdf.
WateReuse Association, American Water Works Association, Water Environment Federation, and National Water Research Institute. 2015. "Framework for Direct Potable Reuse." Project 14-20. https://watereuse.org/wp-content/uploads/2015/09/14-20.pdf.
Western States Water Council. 2012. *Water Reuse in the West: State Programs and Institutional Issues.*
World Health Organization. 2017. "Potable Reuse: Guidance for Producing Safe Drinking Water." http://apps.who.int/iris/bitstream/handle/10665/258715/9789241512770-eng.pdf;jsessionid=1CA76772277CB1A8E6362F287EC5F496?sequence=1.
World Health Organization. 1989. *Health Guidelines for the Use of Wastewater in Agriculture and Aquaculture.*

To be Considered:
Bluefield Research, *U.S. Municipal Water Reuse: Opportunities, Outlook & Competitive Landscape 2017-2027. 2017. ($3500)*

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