DRINKING AMERICAN RAIN?

Motivations to adopt or reject rainwater-to-potable systems for nonresidential buildings

Problem:

The ‘replacement era’ has arrived for American water infrastructure. Costs loom large and resilience, redundancy, flexibility, and ‘soft path’ concepts are being explored in other sectors. Is there a place for rainwater in the future of American drinking water infrastructure?

Opportunity:

Only twelve nonresidential building sites in the U.S. are currently exploring how rainwater collection can supplement or supplant conventional drinking water supply models. The Safe Drinking Water Act does not define a clear place for rainwater as a source for ‘public water systems’ that serve 25 or more people for at least 60 days per year. These twelve projects, seven of which are operating, are testing boundaries at the bleeding edge of ‘net-zero water’ buildings and cities.

Research:

Through background literature, water sampling, and interviews with project-specific, national, and international experts, this research identifies forces that motivate adoption or rejection of rainwater for drinking and why only seven such currently operating examples exist. Of the twelve known examples, this research investigates six projects in four eastern U.S. states: Massachusetts, Virginia, Georgia, and Alabama.

Key Findings:

Using a proposed framework that combines diffusion of innovation theory with socio-technical transition theory, the study identifies 40 forces acting upon building owners, 16 to adopt and 24 to reject (see sample on next page), which influence whether a well-resourced owner achieves its goal.

- Nonresidential building owners adopt rainwater for drinking primarily to demonstrate environmental commitment despite affordable, reliable, and good-quality alternatives and considerable costs, largely driven by drinking water quality standards;
- An interconnected set of laws, regulations, and costs generally intended to protect public health create barriers to entry for new ‘public water systems’, and particularly so for small, rainwater-fed systems;
- No evidence is discovered that public supply water or bottled water available at the six studied sites contains elevated concentrations of metals of concern, though improving drinking water quality is often cited as a motivation to switch to new sources of water supply; and
- Further research is needed into how changes in rules and regulation may help drive down costs, maintain public health, and support continued exploration of rainwater as part of American drinking water supply infrastructure.

Why it Matters:

20th century water utility business models, system designs, and technologies are built on 20th century development and consumption patterns and expectations of water resource supply (i.e. climate). Each is evolving and challenging the resilience of American drinking water infrastructure. An $85 billion annual financing gap compels creative thinking about how to build and manage the American drinking water infrastructure of the future. This research reveals that evolving U.S. drinking water infrastructure will require thinking differently about risk, cost, and scale. As an unnamed and uncodified drinking water resource for the U.S., rainwater will continue to be integrated as a source of supply only at the margins.

Green building certification schemes such as the Living Building Challenge (LBC) are inspiring efforts to test various technical, regulatory, and project development boundaries, illuminating what is possible in future applications. This study adds to a small but growing and urgent body of research into net-zero water buildings and their influence on water systems, offering new grounds for further, timely research.

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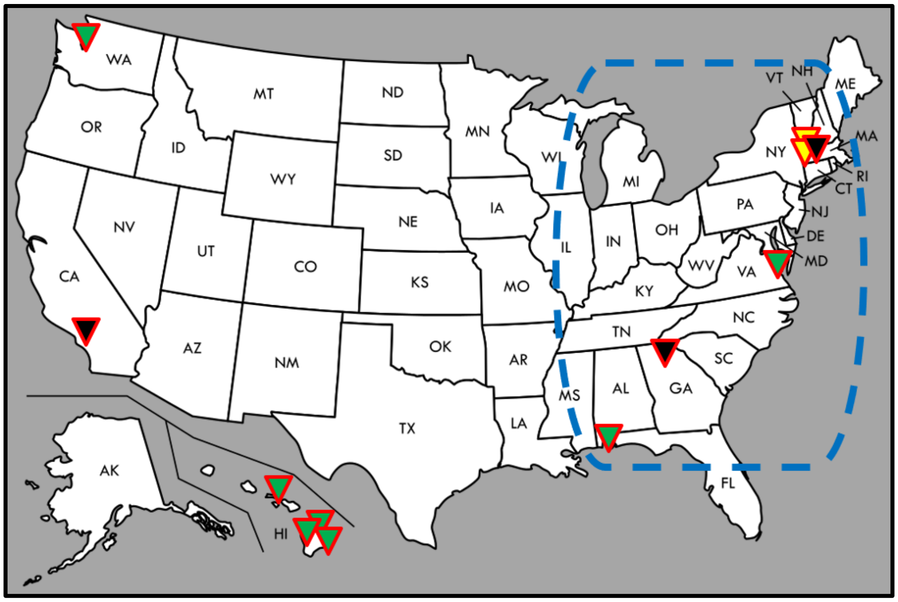
Studied Projects

Gulf State Park Interpretive Center (AL); Kandeda Building for Innovative and Sustainable Design (GA); Class of 1966 Environmental Center, R.W. Kern Center, and Hitchcock Center for the Environment (MA); and Brock Environmental Center (VA).

Rainwater systems at nonresidential buildings in U.S. with (or seeking) permits to operate as a 'public water system'



Qualitative Methods and Results

19 project-specific interviews include perspectives from regulators, owners, designers, and operators. 15 other interviews offer insights into these perspectives and explore context on rulemaking, rejected rainwater-to-potable systems, and the international landscape for rainwater as a source of drinking water supply. A proposed theory identifies 40 forces, including 16 to adopt and 24 to reject a rainwater-to-potable system at nonresidential buildings in the U.S.

Twelve strongest identified forces at studied sites

	Reject	Adopt
Personal Forces	High cost to operate High up-front costs	System owner wants to boast green credentials Drinking rainwater matches owner's values or they just want to do it
Local Context Forces		Funding requires investment in rainwater-to-potable system or deep green options
Socio-Technical Forces	Piped water supply is affordable and reliable Rainwater-to-potable system is not simple and requires maintenance Regulatory uncertainty or complexity	To experiment with new technologies to achieve building and water resilience To prove the viability of rainwater-to-potable systems
Societal and Natural Landscape Forces	Legal – national laws	To change the public discourse about rainwater as a resource

Additional Insights:

The study uncovers several topics that do not motivate the adoption or rejection of rainwater for drinking, but that add context for answering the research questions. The paper explores perspectives on risk, liability, and insurance; communication; innovation; and on technical elements, particularly disinfection methods. Further study is proposed in these areas and also in both policy reform and further geographies.

Context from the Literature:

73%

- *of rainwater systems in USA are fewer than 5 years old* (Thomas et al., 2014).

$1 trillion

- *investment needed over next 25 years to maintain, upgrade, and expand U.S. water infrastructure* (ASCE, 2017; AWWA, 2017).

2 million

- *Americans without reliable access to clean drinking water* (McGraw, 2019).

2,056

- *studied intakes for U.S. drinking water treatment; half of which are downstream from wastewater discharges, resulting in large de-facto reuse* (Rice and Westerhoff, 2015).

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- *section of Title 40, U.S. Code of Federal Regulations where the National Primary Drinking Water Regulations do not name rainwater as a resource* (EPA, nd-a).