

Project: Understanding the Factors that Influence Outdoor Residential Water Conservation: A Case Study in Suburban Boston

Project Leader: Robert Ryan

Project Overview

In the face of recent droughts and climate change impacts, water conservation is critical for meeting water demands of humans and freshwater ecosystems. Since residential landscaping is a major component of domestic water use, efforts to promote outdoor residential water conservation are critical. Water harvesting using rain barrels, infiltrating stormwater using rain gardens, and landscaping with native plants have been promoted through outreach campaigns as a means to reduce water use and provide ecosystem benefits. There is a need to understand how these recent water conservation outreach efforts impact local residents' attitudes towards and behaviors incorporating these low-impact development (LID) strategies, and subsequently lead to measureable improvements in water conservation and ecosystem health. In addition, it is important to understand the formal and informal role the green industry plays in promoting residential landscape water conservation.

Situation and Priorities

The Ipswich and Parker River watersheds north of Boston drain into the biologically rich Plum Island Estuary. The Ipswich is considered one of the most threatened rivers in the US, due to polluted stormwater runoff and overdraft of water by local communities. Water conservation and stormwater management are critical priorities for local government agencies faced with frequent water shortages and impaired water quality. This initiative will examine the influence of policy and outreach efforts on local residents' adoption of water conservation and stormwater strategies in the residential landscapes of the Ipswich and Parker River watersheds. The project team will assess the impacts of land use change on water use and the potential for green stormwater infrastructure to restore watersheds while creating a new line of research and outreach inquiry focused on linkages between local policies, outreach efforts, and household decisions related to water conservation.

Activity Summary - 2016

- Website/webpage on residential water conservation for homeowners (1)
- Stacy, Johanna, Ryan, Robert, Milman, Anita, and Roy, Allison H. (draft). Homeowner Willingness to Adopt Environmentally Beneficial Landscape Practices in an Urbanizing Watershed (working title). Draft article in preparation for submittal to *Landscape Journal* in late fall, 2016.(1)

- Danford, Rachel, Milman, Anita, Roy, Allison, and Ryan, Robert (draft). “The Role of Small Municipal Water Suppliers in Residential Demand-side Management” (working title). Draft article in preparation for submission to *Cities and the Environment* in late fall, 2016.(1)
- Training/advising of Phd student in interviewing and data analysis. Training of master's level student on survey design.(1)
- Brochure on residential water conservation “Residential Rain Gardens and Water Conservation” for homeowners (1)
- Interviews with homeowners involved in residential water monitoring project (25)
- Data set of water monitoring of residential water use (25)
- Poster presentation at Massachusetts Nursery and Landscape Association (1)
- “Factors Influencing Household Outdoor Residential Water Use Decisions in Suburban Boston” (USA), MS Thesis, Emily Argo, 2016 (1)
- Training/advising of Phd student in interviewing and data analysis. Training of master's level student on survey design. (3)

Total educational contacts

	Adult Contacts
Direct Contact	268
Indirect Contacts (Print, Web, etc...)	598

Narrative Summary and Impact

Goal 1 - To identify local policy and outreach efforts across the watershed and to evaluate connections between those and the adoption of LID practices

Studies and Results

Residential water use is increasingly being viewed as an essential component of sustainable water management. Research has predominantly focused on the potential savings from specific residential demand-side management (DSM) tools, with scant attention to the processes by which decisions are made to implement these tools. Yet DSM the policies and programs selected by water suppliers to achieve residential water conservation will have a direct impact on water-use patterns. Our focus over the past year has been to investigate the external and internal factors that drive decision-making and DSM implementation by small residential water suppliers. Semi-structured interviews of state, local, and non-profit organizations were analyzed together with secondary data on water withdrawal permits and interbasin transfer agreements to characterize water conservation policies and programs within the Ipswich and Parker watershed. (Interview sample: 11 water supplier officials, two MA Department of Environmental Protection officials, and three employees from non-profit community groups.)

We find substantial heterogeneity in the DSM policies and programs implemented by water suppliers. While state mandated residential water efficiency requirements are similar across communities, the requirements allow flexibility in how suppliers may achieve residential water conservation. Consequently, suppliers vary in their level of engagement with DSM. Analysis of the interview data suggests decision-making at the supplier level is influenced by water supplier attitudes toward water conservation and perceptions of organizational capacity, and often ensues without

information on the structural (device-saturation, lawn area, etc.) and non-structural (residential attitudes, community norms, etc.) factors that influence DSM tool effectiveness.

The original research results from this analysis were summarized in a research manuscript in which we developed of a conceptual model of water supplier decision-making. The manuscript was submitted to two international journals in December 2014 and then in May 2014. Although the manuscript was favorably reviewed, in both cases it was ultimately rejected due to the small, regional nature of the sample. After reviewer and editor feedback, the manuscript is being re-written with an emphasis on DSM for submission to a journal with a regional focus

Data collected for this goal was used for sample selection in goals 2 and 3, and may also be used in combination with data collected in the other goals to investigate how top-down policies influence decision-making at the residential level.

Significance

Our findings have provided significant insights about the role of water suppliers in shaping residential water conservation policy, as well as on the process by which water suppliers make DSM decisions. This work has provided necessary background information for goals 2 and 3 as well as served to establish relationships with stakeholders that will be useful for dissemination of overall findings. More broadly, findings from goal 1 indicate potential inefficiencies in the current support system for decision-making at the water supplier level that may be improved by tightening connections between residents and suppliers.

Goal 2- Homeowner Attitudes Survey

Urbanizing watersheds often face water shortages due to increased water use for residential landscaping and decreased base flow as impervious land cover limits aquifer recharge. Low-impact development (LID) practices, specifically those that infiltrate runoff, have the potential to keep more water in the watershed, and increase base flows in the river. This study explored the barriers and motivations that exist to LID adoption by local residents in the Ipswich River watershed north of Boston, Massachusetts that experiences seasonal water shortages. The study used a postal and on-line survey with images of different low-impact development practices including rain gardens and native plantings and items about homeowners' watering practices, likelihood of adopting innovative residential landscape practices to save water, and attitudes towards environmental issues in the region. The results found that local residents (n=265) were aware of existing water shortages and supportive of water policies to restrict use. In addition, their willingness to adopt innovative landscape practices were influenced by their aesthetic response with more support for those practices that appeared neat and cared for rather than those that were more rough and unkempt appearing. Barriers to residential adoption of these landscape practices included concern about disease-carrying pests and the perceived cost of landscape change. Knowledge about the environment, as operationalized by membership in a local watershed association, as well as educational attainment and income were significant variables in predicting aesthetic preferences and willingness to adopt LID practices. While survey response rates were highest among watershed members, membership in a watershed association did not correlate with a stronger willingness to adopt these landscape practices or an increase in the number of existing features on homeowners' property. Those with higher income and education were, however, more willing to adopt these practices. Some discrepancies exist among groups between stated willingness and aesthetic acceptance of these landscape, where respondents indicated they were less interested in adopting the

practice, but when shown a photo, were much more interested. The findings emphasize alternate strategies for land use planners, landscape professionals and environmental organizations to promote behavioral changes in the way residential landscapes are managed, and policies municipalities could adopt to implement more widespread use of LID practices.

Goal 3 - Residential Outdoor Water Use Behavior- Homeowner Water Monitoring Study

Outdoor water use accounts for the largest proportion of residential water use during the summer months. Studies often focus on the relationship between total outdoor water use and property features such as lawn area and the presence of a pool. However, these studies do not capture the series of decisions by residents that result in the total outdoor water use and there is limited research on water use decision-making. This research combined both qualitative and quantitative data to develop a more complete picture of residents' outdoor water use and the factors influencing the amount and timing of their water use. Specifically, focusing on two questions, 1) how do people decide whether or not to use water outdoors on any given day? 2) does a person's belief that residents need to be conserving water correspond to their total outdoor water use and willingness to implement conservation practices?

To quantify water use, water meters were placed on outdoor spigots at 34 residences in the watershed from August-October 2014 and May-October 2015. Residents recorded the date, time, amount of water used, and purpose of water use for outdoor water use events. To complement the water use data, participants were provided with a written survey pre and post their participation in water metering. In-person semi-structured interviews were conducted with 20 of the water metering participants. Outdoor water uses included filling the pool, filling the birdbath, pet care, and cleaning (lawn mowers, cars, etc.). Lawn watering had the greatest average water use; however the range was high suggesting that lawn watering is difficult to predict.

In particular, the study found that residents with automatic irrigation systems and private wells used significantly more water than participants who hand watered and had public water supplies. Participants could be separated into three groups based on their outdoor water use decisions: weather mediated scheduled watering, weather and plant appearance mediated non-scheduled watering, and unmodified irrigation schedules. However, the study did not find any significant difference between willingness to implement conservation practices, standardized total water use and belief in the need for water conservation.

Results of this study were presented at the Society for Freshwater Science in May 2016. Information about water use and residents' motivations were used to identify outreach approaches to encourage outdoor water conservation.

Goal 4 - Enhance Local Agencies' Outreach Effort to Promote Water Conservation

This research year we focused our efforts on packaging and marketing the study's research result for outreach to local planning and water provider agencies. The extended drought faced by the Commonwealth of Massachusetts during 2016 increased the receptiveness of local governments and non-profit groups to this information.

Our team produced a brochure that focused on summarizing our research results about homeowners' attitudes toward residential low impact development (LID) and water conservation techniques in the Ipswich River Watershed by Stacey (2015). The brochure outlined information from our study, UMass Center for Agriculture publications, and other resources for water conservation, such as techniques to limit water use on lawns. The brochure also provided information about rain garden design and

construction. In addition, the team produced a bookmark about residential water conservation techniques. The first printing of 200 brochures and bookmarks was produced and distributed at the Massachusetts Nursery and Landscape Association summer conference in July, 2016.

After receiving some minor feedback, the bookmark and brochure were revised for the Ipswich River Watershed. To date, 380 brochures and bookmarks were distributed to 12 towns in the watershed (planning departments and water utility providers), as well as to the non-profit Ipswich River Watershed Association. In addition, the Town of Danvers was provided with a digital version of these materials for a reprinting and distribution.

In addition, the general brochure and bookmarks (110 copies) were distributed to five towns in the Pioneer Valley (Amherst, Northampton, Hadley, Turners Falls, and Chicopee) as well as to the Pioneer Valley Planning Commission (PVPC). We targeted these mailings to planning departments in local towns with mandatory water conservation regulations in force.

Digital versions of all outreach material will be made available at the Center for Resilient Metro-Regions web-page link that focuses on this project. We have also prepared detailed web-information on designing a rain garden, as well as techniques for water conservation. This web page will go live in the late fall of 2016.

We also produced a draft article about the research results and insights for water conservation for publication in the newsletter/magazine of the Massachusetts Landscape and Nursery Association. The members of MNLA are leaders in the green industry and have an impact on residential landscaping decisions.

Collaborating Organizations

- **Ipswich River Watershed Association**
- **Massachusetts Watershed Coalition**
- **Massachusetts Nursery and Landscape Association**
- **Massachusetts Association of Landscape Professionals**
- **Martin's Pond Association**
- **Town of North Reading**

