

# Barriers to Green Infrastructure in the Hudson Valley: an electronic survey of implementers

## Executive Summary

Green infrastructure practices maintain or restore stormwater's natural flow pattern by allowing the water to slowly soak into the ground and be used by plants. There are numerous successful examples of green infrastructure practices in the Hudson Valley, but there are many potential difficulties to its being adopted as a routine aspect of development, including local government regulations, site constraints, engineer training, developer enthusiasm, public perception, and many more.

We conducted a survey to identify the largest roadblocks to its implementation in the ten counties of the Hudson River Estuary Program. We received information from a wide range of green infrastructure practitioners—geographically broad, with diverse positions in their communities and having experience with many different types of practices. Respondents cited cost, lack of knowledge, and resistance from local, municipal officials as the top barriers to implementation of more green infrastructure in the Hudson Valley. Respondents were looking for funding for design and implementation of green infrastructure practices, as well as money for ongoing maintenance. They believed that there is a perception of high cost around these practices. Regulatory barriers were not rated as highly, but our survey highlights an important distinction between local laws and local officials. Respondents did not feel that local laws were restrictive or unclear, but cite the local level of development review (including planning board members, conservation advisory council members, consultants, and building inspectors) as one of the largest barriers to more implementation of green infrastructure. Cultural barriers that deal with community acceptance of green infrastructure were not seen as large barriers. The responses make it clear that in addition to more funding sources, there is a great need for outreach and education to local governments to familiarize them with the functions and possibilities of green infrastructure practices.



Planting a rain garden at SUNY Orange, Middletown (photo: Kirsten Gabrielsen)

## Survey Respondents

Between December 2011 and January 2012, the Hudson River Estuary Program conducted a survey to better understand the barriers to implementing green infrastructure in the Hudson Valley. A link to the survey was sent out to the email lists of Emily Vail and Andrew Meyer, and we encouraged people to pass it on to interested parties. We specifically targeted landscape architects, builders and engineers. We received 127 completed responses. Because we sent the survey link to people who have been involved in our programs, this is not a representation of the general public's sentiments but more a representation of those involved in green infrastructure implementation. At least one person from each county within the Hudson River estuary watershed participated in the survey (Figure 1), with the fewest responses from Rensselaer and Greene counties.

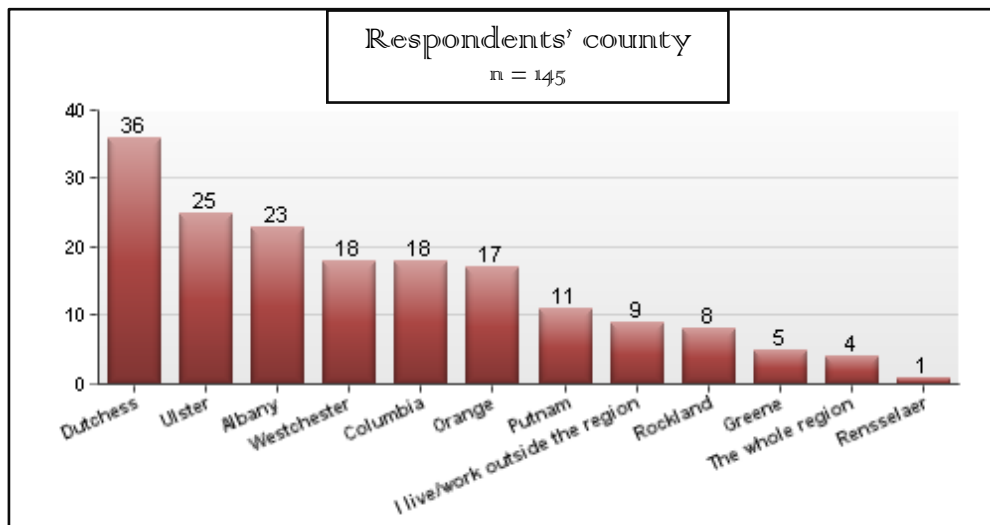


Figure 1. Respondents' county

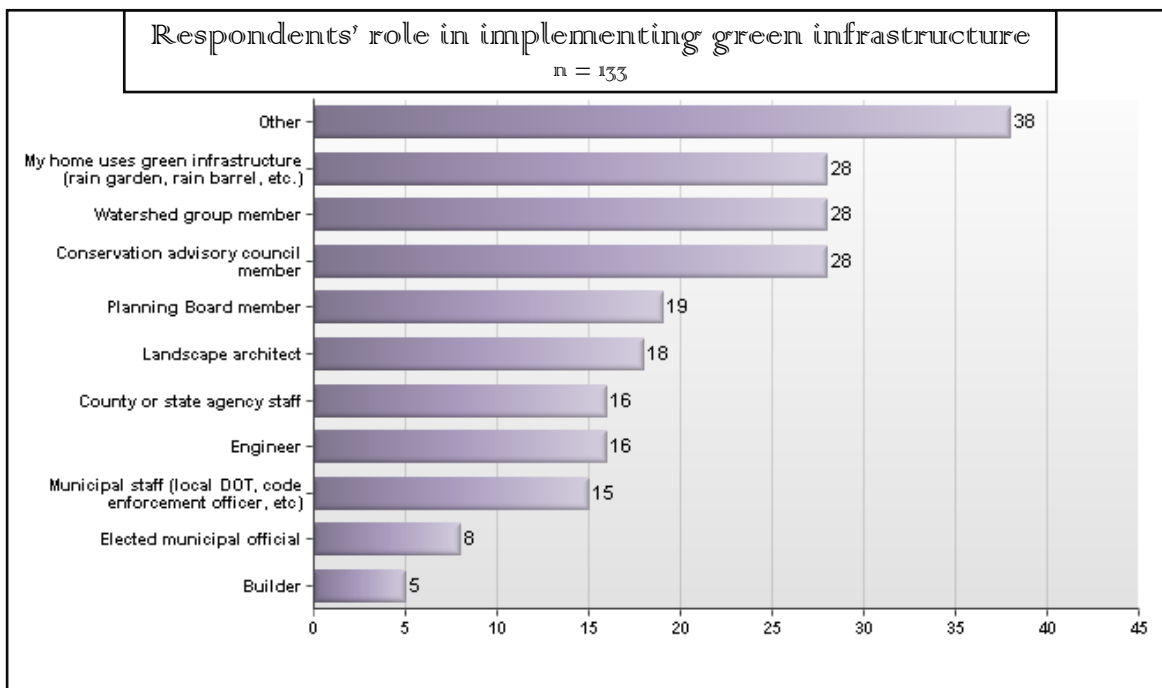


Figure 2. Respondents' role in implementing green infrastructure practices

The respondents' roles in green infrastructure implementation varied widely, from municipal staff and officials to professional builders, to homeowners that use green infrastructure techniques (Figure 2). Many respondents listed "other" in this category, and further information shows several of the respondents had municipal staff positions such as stormwater management officer and commissioner of building and planning.

Respondents were involved in a wide variety of green infrastructure practices (Figure 3); bioretention/rain gardens and preservation of existing natural areas were cited most often and green roofs and downspout disconnection the least. "Other" responses often mentioned education as well as the preservation of wetlands. (These responses could be included under the "preservation of natural areas" option and would add several more responses to this category.) There were no geographic trends in the types of green infrastructure projects that respondents were involved in. The survey included a question about how often the implementers were involved in green infrastructure practices, and there were no trends in respondents' types of projects based on their frequency of involvement.

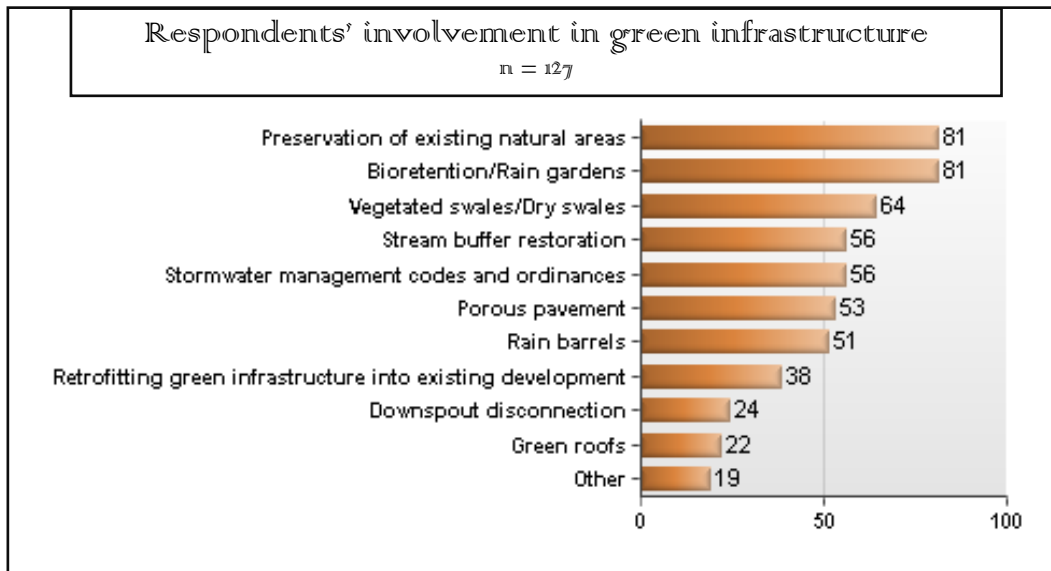


Figure 3. Respondents' involvement in green infrastructure practices

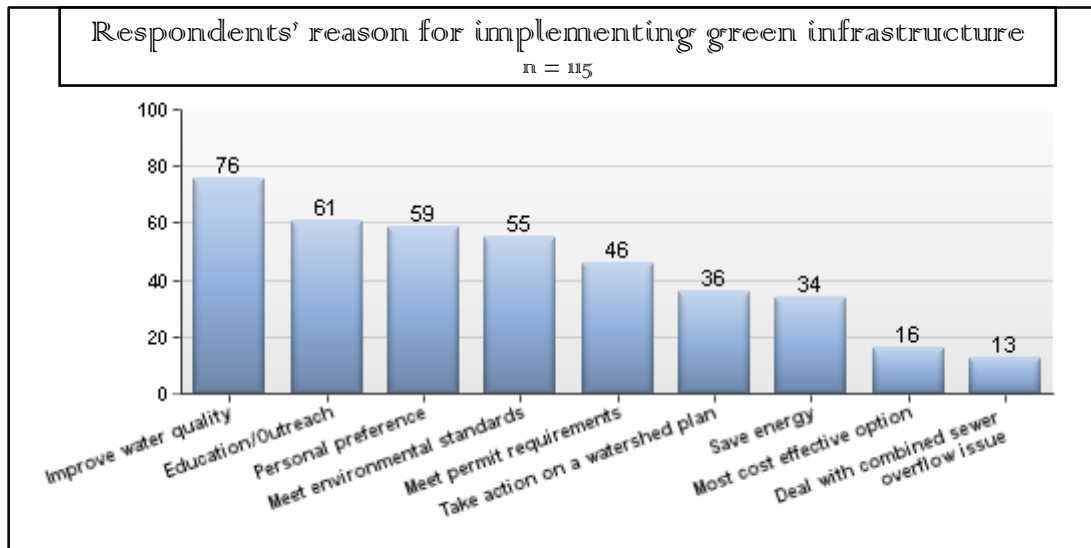


Figure 4. Respondents' reasons for implementing green infrastructure practices

Figure 4 shows that most respondents implemented green infrastructure to improve water quality, but personal preference, education/outreach, as well as regulatory requirements such as meeting permit requirements and meeting environmental standards were also cited often.

### Largest Barriers to Green Infrastructure

When asked an open-ended question about the largest barrier to implementing green infrastructure in their community, responses fell into three categories. Cost was listed as the largest barrier to green infrastructure implementation, getting 30% of the total responses. 25% of respondents cited a lack of knowledge and 22% mentioned unfamiliarity and resistance from local governments. These last two categories often overlapped and several respondents mentioned them both. A typical response states “lack of knowledgeable local officials and



Examining the green roof at Marist College, Poughkeepsie (photo: Mary Ann Cunningham)

review consultants” as the largest barrier, showing that knowledge and experience at the local level is a large problem for green infrastructure implementers. Multiple town-level positions were specifically mentioned for resisting green infrastructure progress, including conservation advisory committees (CACs), consulting engineers, building inspectors, highway departments, and planning board consultants. Though cost was the largest barrier, our results showed that just behind that is a nexus of missing knowledge, specifically at the level of local government, emphasizing the importance of education to all manner of local agents in the building permitting process. One other barrier received multiple mentions—existing site constraints. Several responses elaborated on this, stating that green infrastructure posed difficulties on small lots.

Following this question which allowed a written response, a series of questions asked respondents to rank barriers as “large,” “moderate” or “not barriers” to green infrastructure (Table 1). Barrier options were grouped into technical/physical, legal/regulatory, financial, and cultural barriers. The categories are similar to those used in a national survey, Clean Water Alliance’s Barriers and Gateways to Green Infrastructure report (<http://www.cleanwateramericaalliance.org/pdfs/gireport.pdf>), and will allow us to place the Hudson River Estuary results in a national context. Table 1 shows the average response weight for all the barriers in our survey. Four of the top five barriers were in the financial group of barriers, along with a lack of knowledge and experience in the development community. Figure 5 shows the barriers ranked from largest to smallest.

Category	Question	# of Responses	Response Weight
Technical and physical barriers	Not enough technical knowledge and experience in development community	113	<b>3.00</b>
	Lack of design standards, best management practices, etc.	104	1.77
	Limited access to necessary materials (e.g., porous asphalt)	100	1.51
	Limited appropriate sites (due to soil, space, etc.)	102	1.37
	Research hasn't proven benefits yet	109	1.02
Legal and regulatory barriers	No long-term municipal structure for maintenance and ownership	96	2.50
	Local rules are lacking or restrictive	104	1.91
	Local laws are unclear	101	1.73
	State policies are lacking or restrictive	96	1.59
	State policies are unclear	94	1.45
Financial barriers	Not enough incentives	108	<b>3.04</b>
	Perceived high costs (short-term and/or long-term)	110	<b>3.04</b>
	Lack of funding for design and implementation	108	<b>2.95</b>
	Lack of funding for ongoing maintenance	104	<b>2.95</b>
	Not enough information about costs and benefits	110	2.47
Cultural barriers	Green infrastructure is undervalued by development community	112	2.61
	Community is not convinced about its effectiveness	111	2.29
	Lack of cooperation between agencies and communities	105	2.12
	Not enough information/Don't know where to get information	114	1.46
	People worry about how it looks	102	0.84

Table 1. Respondents’ mean response weight for potential barriers to green infrastructure, broken up into four categories. The five barriers with the highest response weight are bolded.

- ❖ Responses in the **technical/physical** group showed that a lack of developers' technical knowledge and experience was the biggest barrier. In general, respondents felt there was enough research to prove the worth of green infrastructure.
- ❖ When asked about **legal/regulatory** barriers, missing long-term municipal capacity to own and maintain green infrastructure received the highest ranking. Local laws and regulations were not rated as highly.
- ❖ **Financial** choices were all ranked very highly as barriers to green infrastructure implementation, with perceived high costs and lack of incentives scoring the highest of any barriers in any question.
- ❖ **Cultural** barriers were not ranked highly, though green infrastructure was seen to be undervalued by the development community. Based on its lowest place ranking among all the barrier choices, the aesthetic qualities of green infrastructure were not seen as a large barrier to its implementation.

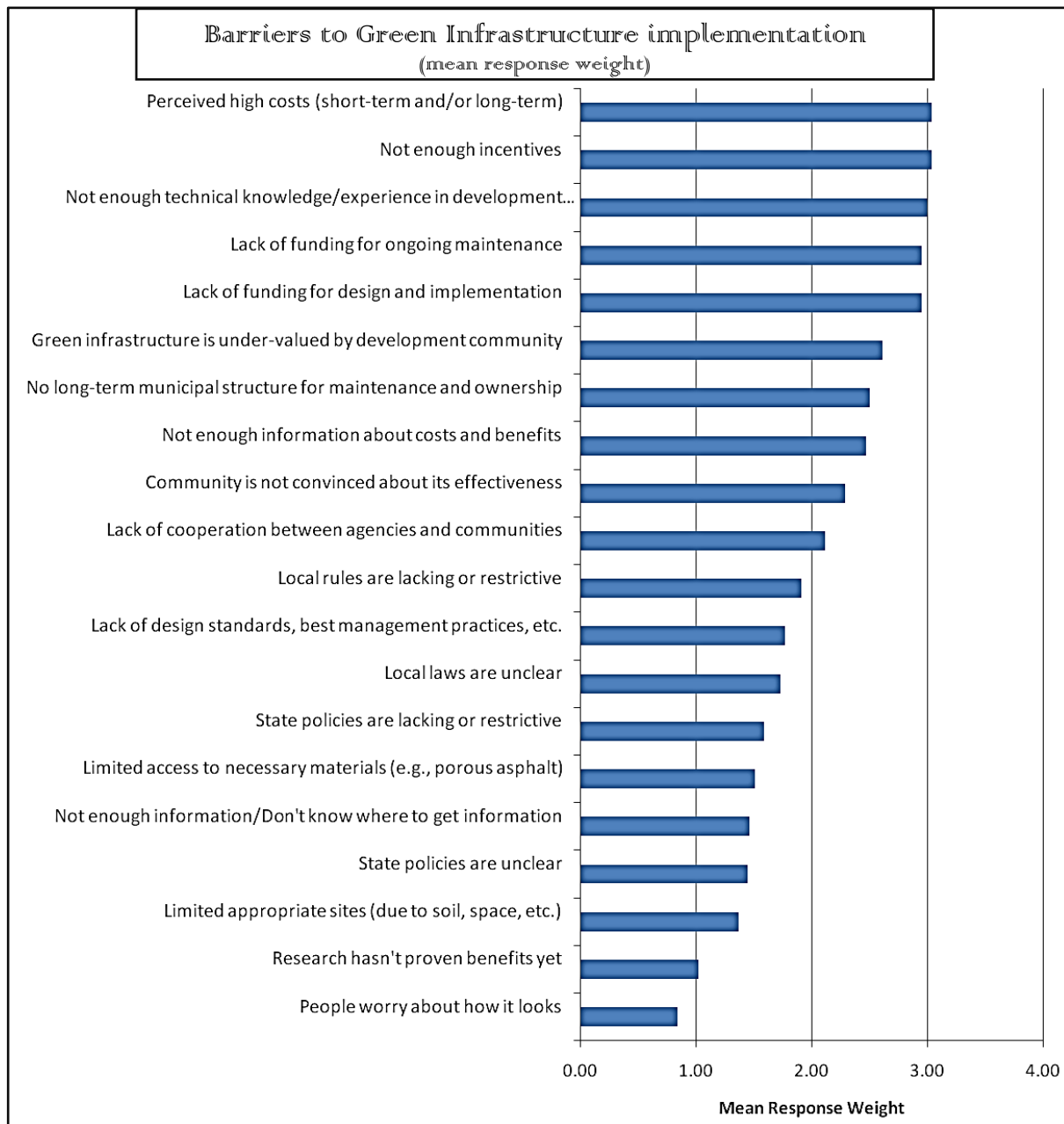


Figure 5. Ranked mean response weight of barriers to green infrastructure implementation

Some patterns emerge when looking at the question of barriers in different regions of the Hudson Valley. In Albany, Rensselaer, Greene, and Columbia counties, the four northern counties of the estuary watershed, cost was even more of an issue than the average results. Cultural and legal/regulatory barriers to green infrastructure were rated lower than the average results, except that respondents felt that their community was not as “convinced about its effectiveness” as the average respondent. In the six southern counties (Ulster, Dutchess, Orange, Putnam, Rockland, and Westchester), technical and physical barriers were rated as larger barriers than the average results, except “lack of design standards,” which was still not rated highly by this group. In the three most urbanized counties, Albany, Rockland, and Westchester, legal and regulatory hurdles were viewed as less of a barrier to green infrastructure implementation than in the average results. In these counties, fewer respondents felt that there was “not enough information/don’t know where to get information,” “limited access to necessary materials” or a “lack of design standards, best management practices”; but, more respondents felt that there were “limited appropriate sites.” In these counties, cultural barriers were rated lower than the average results except for “people worried about how it looks.”

When looking at the rankings of barriers by municipal officials and staff (including planning board members) technical and physical barriers became more of a concern. The municipal subset of respondents was looking for more information—“Research hasn’t proven benefits yet,” “Lack of design standards, best management practices,” “Not enough technical knowledge and experience in development community,” and “Not enough information about costs and benefits” were all ranked substantially higher than the average responses. The high rankings of these categories by municipal officials and staff suggest that education focused at the local government level would not only be important (they were often cited as a barrier by other groups), but would also be well received. Municipal officials, staff and planning board members responded that the development community undervalued green infrastructure. Interestingly, this municipal group viewed long-term municipal maintenance and ownership as less of a barrier than the average respondent.



Planting a tree along a stream in Beekman, as part of the NYS DEC Hudson Estuary Trees for Tribes initiative (photo: Beth Roessler)

When builder, engineer, and landscape architect respondents were grouped, a much different picture emerges. Legal and regulatory barriers were much more of a problem for these respondents than the average results, both at the local and state level. These green infrastructure practitioners also were not convinced that its benefits have been proven, but didn’t think that design standards are needed. They also believed that limited appropriate sites were a big concern and feel that the public’s perception of the aesthetics of green infrastructure was a substantially larger barrier than the average respondent. Outreach to this audience should include case studies and local practitioners that have been involved in successful projects, to help convince them that the practices do occur and clarify when green infrastructure is appropriate

Respondents from towns working outside Municipal Separate Storm Sewer System (MS4) areas rated the majority of options as larger barriers than the average respondent (Figure 6), sometimes much larger. Non-MS4 respondents felt that legal/regulatory and financial barriers were all higher than the average respondent, and felt strongly that state and local laws were unclear, green infrastructure was under-valued by the development community and that their communities were not convinced about green infrastructure’s effectiveness. Conversely, all

legal/regulatory, and financial barriers, and all but one cultural barrier were rated lower by respondents in MS4 communities. For respondents from MS4 areas, the technical/physical barriers of a lack of design standards and few appropriate sites, as well as the cultural barrier of people worrying about how the practices looked received substantially higher score as a barrier to green infrastructure. The substantial number of barriers rated higher by non-MS4 communities suggest that municipalities within the MS4 program are more familiar and comfortable with the resources available to them than non-MS4 municipalities. This information has clear implications to outreach and education efforts—non-MS4 communities have much different problems moving green infrastructure forward and are concerned about many more issues than MS4 communities.

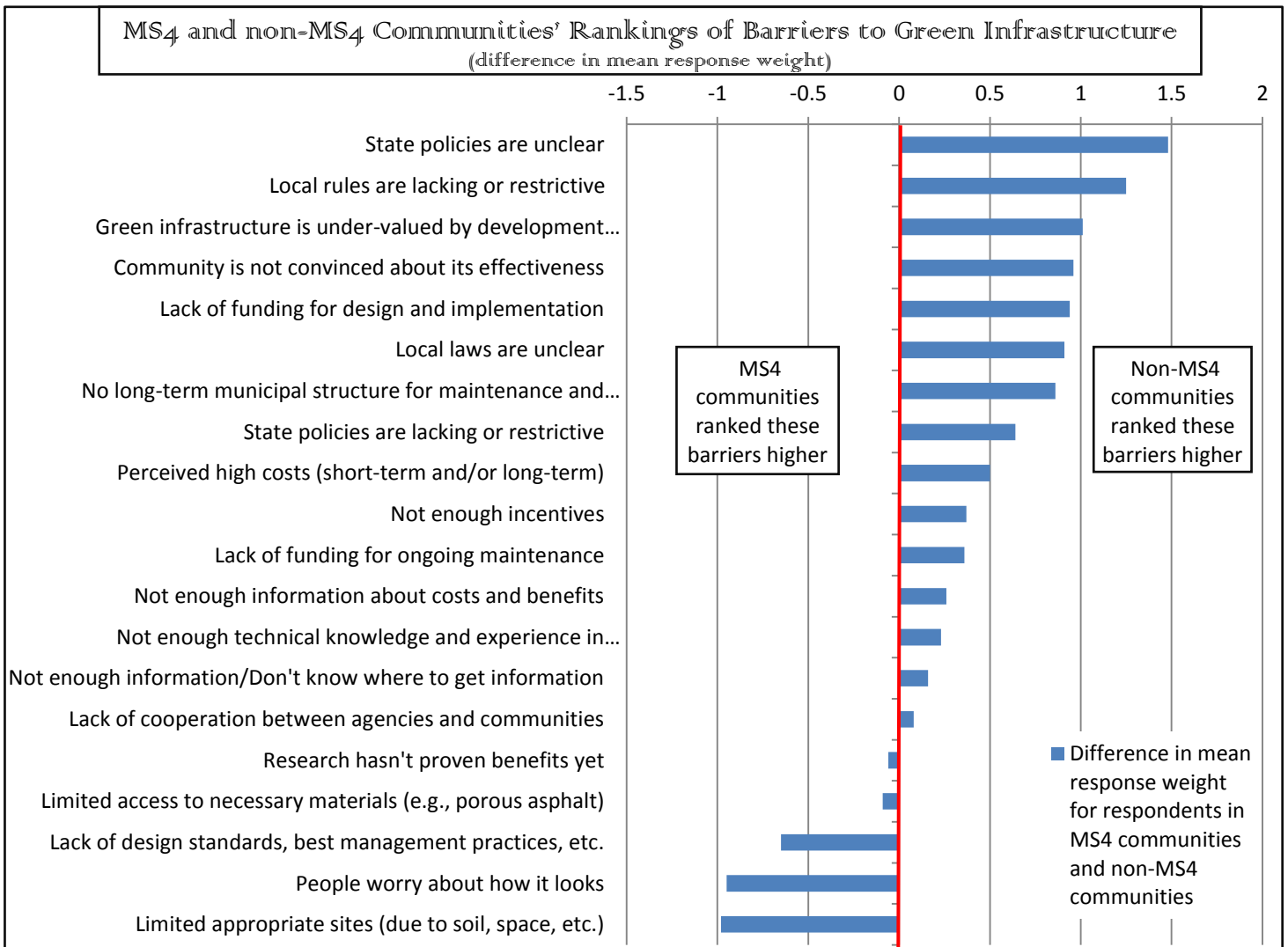


Figure 6. Shows the difference in barrier mean response weight based on whether the respondent answered affirmatively that their community meets MS4 requirements or not. Positive results indicate the barriers that were rated higher by non-MS4 respondents; negative results are barriers rated higher by MS4 respondents.

## NYS Stormwater Management Design Manual

The NYS Stormwater Management Design Manual (<http://www.dec.ny.gov/chemical/29072.html>) was updated in 2010 to include a chapter on green infrastructure. This is an important resource for technical standards of green infrastructure practices. Overall, 31% of respondents reported they had read the Design Manual, 35% had read

parts of it, and 34% had not read it. Based on survey responses, municipal staff, engineers, landscape architects, and county or state agency staff were most likely to have read all or part of the Design Manual (Figure 7). By a wide margin, respondents identifying as elected municipal officials were least likely to have read the manual, although more than 25% of CAC members and watershed group members also have not read the manual. In general, the people who have read the manual have used it to implement projects. Of the people who hadn't read the Design Manual, about half of them had never heard of it. There were no geographic trends in respondents' familiarity with the manual.

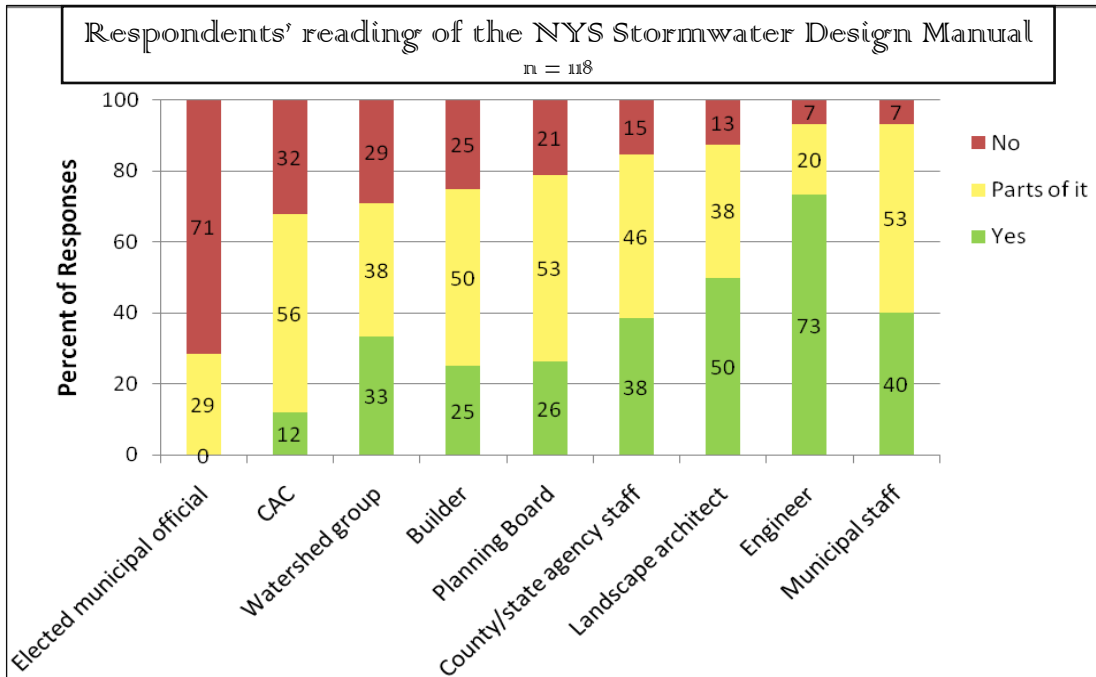


Figure 7. Respondents' familiarity with the NYS Stormwater Manual based on their role in their community

An open-ended question about the accessibility and usefulness of the manual drew a wide range of responses. While some thought it was difficult, overly technical, and confusing, others thought it was a great, useful, and well-organized resource. About 29% of responses can be classified as positive, compared to about 12% of responses that were negative. Some of the comments were both negative and positive, and many had other observations or comments about the Design Manual. (For example, one respondent said, "useful for sizing criteria, less so for planning and runoff reduction, really it is a matter of understanding GI, LID, etc. as a paradigm, not a technique.") Many of the comments emphasized the importance of the Design Manual in municipal planning and reviewing site plans.

## Next Steps

We asked several questions that will help us create new outreach materials and programs. This survey has provided us with an understanding of where respondents are currently getting their information about green infrastructure and what topics they are interested in learning more about.

The NYS Stormwater Management Design Manual as well as colleagues and other implementers of green infrastructure are the most useful place for respondents to go for more and new information (Figure 8). This highlights the importance of the Design Manual as a resource for influencing implementers' practices—making sure



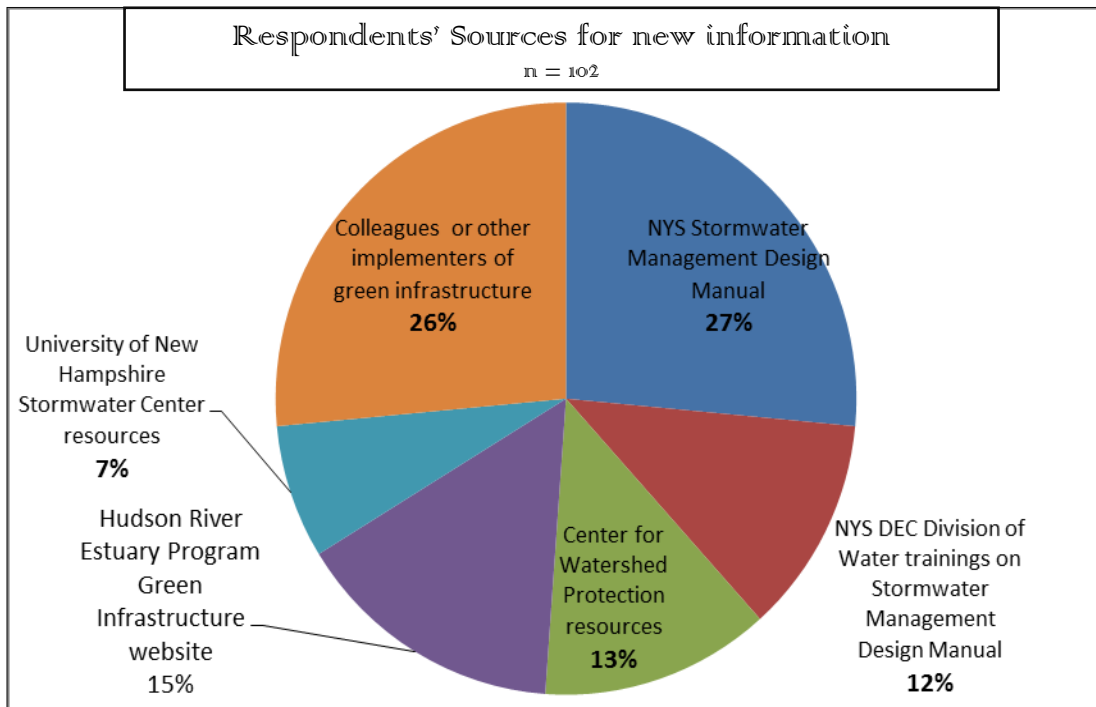


Figure 8. Respondents' sources for new information about green infrastructure practices

the manual or related materials are as user-friendly and as accessible as possible will help green infrastructure become more commonplace. Over 30% of the respondents are also using the Hudson River Estuary Program's Green Infrastructure website (<http://www.dec.ny.gov/lands/58930.html>) to gather information. Many respondents mentioned Cornell Cooperative Extension and their programs throughout the survey area as a useful resource. By a two-to-one margin, respondents are interested in touring examples of green infrastructure in their communities—providing incentive for more green infrastructure bus tours. Through respondents' write-in answers to our "what other resources do you use" question, we've gotten many more resources from agencies around the nation that we can use and share with implementers in the Hudson Valley. The examples of outreach materials from organization throughout the U.S. highlight how important and timely the issues surrounding green infrastructure are to many municipalities, and how great resources can come from local- and county-level organizations.

Respondents also provided very useful information about what topics they are most interested in learning more about. Topics fall out into two general categories (Figure 9). Although there is interest in rain barrels, green roofs, and downspout disconnection, there is much less enthusiasm for those than other green infrastructure practices. That could be because rain barrels are a topic being addressed by several other organizations, and that green roofs are often seen as something that is not practical for most development situations. Respondents who are implementing green infrastructure practices routinely are especially interested in learning more about retrofitting green infrastructure into existing development. For many of the topics, there is a great deal of interest from the respondents, and the local organizations and agencies should emphasize these topics in future outreach.

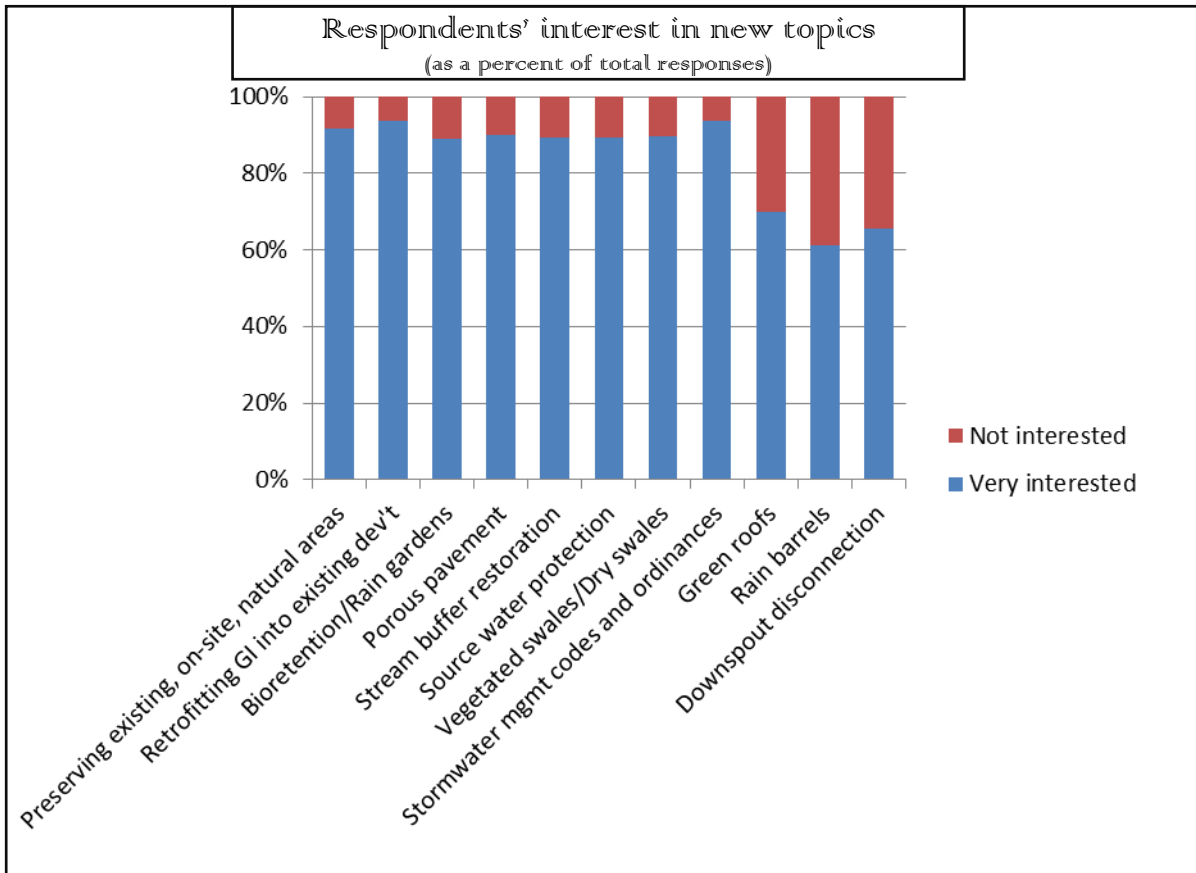


Figure 9. Topics that respondents rated as “very interested” or “not interested” in learning more about

## Contact

This survey was conducted by Emily Vail and Andrew Meyer of the Hudson River Estuary Program and the New York State Water Resource Institute at Cornell University. Please contact them with any questions about the survey or the analysis.

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Hudson River Estuary Program website: [www.dec.ny.gov/lands/4920.html](http://www.dec.ny.gov/lands/4920.html)  
 Helping people enjoy, protect and revitalize the Hudson River Estuary and its Valley