Overcoming barriers to community participation in a catchment-scale experiment: building trust and changing behavior

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Abstract: Communities have an important role to play in the protection of urban streams, particularly with how stormwater runoff from their properties is managed. As part of a larger research project, we used 3 sequential approaches to engage communities in protecting their local creek by managing their properties' stormwater runoff. We assessed their success through surveys and measurements of uptake. Our initial efforts elicited strong interest from the community, but participation rates were greatest when the application process was simplified and barriers to participation were removed. The sequential implementation of the approaches limits inference of their comparative effectiveness, but the results suggest that the iterative and adaptive nature and extended period of the process facilitated the targeting of diverse motivations and the building of community trust, which in turn led to greater community participation.

Key words: community participation, stormwater management, community trust, creek restoration, civic politics, environmental program, sustainability

Urban waterways have long been valued for a range of benefits, including aesthetic, recreational, and civil functions (e.g., Findley and Taylor 2006, Kondolf and Yang 2008). They also have potential to be important contributors to ecosystem services (Dudgeon et al. 2006, Lundy and Wade 2011). The focus of urban waterway management is shifting to include restoration of ecosystem services, and use of dispersed treatment systems for stormwater management is increasing (Bernhardt and Palmer 2007, Cutter et al. 2008, Freni et al. 2010, Olorunkiya et al. 2012). This approach requires direct community engagement in management actions (Green et al. 2012, Hager et al. 2013) because treatment systems are commonly constructed on private land. The approach also requires consideration of the sociocultural context in which management actions are implemented (Yocom 2014) and acknowledgement that the 'community as an actor' can make a difference (Walker 2011).

The Little Stringybark Creek (LSC) project is a catchment-scale ecological experiment in Melbourne, Australia. The project is an attempt to restore an urban stream ecosystem through actions that reduce the impact of urban stormwater runoff (Walsh et al. 2015). Active participation by the catchment community (the owners of private property in the catchment) was critical to the project because ~50% of the catchment's impervious surfaces are on private land. Over a period of 6 y, project personnel used education and incentive schemes to raise awareness of the LSC's values and to encourage the community to act for the creek's benefit by installing stormwater control measures (SCMs), such as rainwater tanks and rain gardens, on their properties. Building community awareness is critical for engendering behavioral change, but community awareness alone has limitations (e.g., Marteau et al. 1998, Shove 2010, McKenzie-Mohr 2013). Therefore, we offered incentives to mitigate the costs of participation (Stern 1999). We

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used a passive adaptive-management approach (Rist et al. 2013) to respond to challenges encountered and community feedback by adjusting educational approaches, incentive types, and SCMs design to increase community participation. In this paper, we describe the approaches used to engage with the community, their evolution during the project, and their relative effectiveness.

ENCOURAGING COMMUNITY PARTICIPATION AND SURVEY METHODS

Mail-outs, the most common medium for informing the community about the project, were delivered regularly before and during each incentive scheme. They informed the community of project aims and progress, the nature of incentives, and public events (e.g., community meetings and raingarden demonstration days). The mail-outs also were used to raise awareness of the existence and importance of the creek (because only ~300 m of creek flows through public land) and threats to creek health. A project website (www.urbanstreams.unimelb.edu.au), neighborhood signs (identifying participating properties), and local newspaper articles contributed to the community information strategy.

Three rounds of incentives were offered (Fig. 1), and they targeted the owners of 833 residential properties connected to the catchment's formal drainage infrastructure. The first 2 were reverse auctions, in which multiple sellers (the community) offered their lowest price to 1 buyer (the project). The use of an auction encouraged co-investment by householders and identified installation costs of SCMs on properties (accounting for owners' willingness to pay). The 3rd round used a direct funding approach, aimed at maximizing participation.

The 1st incentive round (March 2008–March 2009; Fig. 1, Table 1) was a sealed-bid, uniform-price auction (Ausubel 2003, Nemes et al. 2014). Participating householders submitted a bid identifying their proposed SCM and the minimum incentive they required to install it. Bids were assessed by an environmental benefit (EB) score (an index of the degree to which 4 objectives were met, scaled by area; Walsh et al. 2015) and ranked by cost/EB. The cheapest bids were accepted until the funding pool was expended. Accepted bids were paid a uniform price (cost/EB) for the EB they provided (Fletcher et al. 2011, Nemes et al. 2014).

Round 2 (February 2010–June 2011; Fig. 1) was a rising, uniform-price clock auction (Table 1; Ausubel 2003). The auction price rose incrementally over time, and participating householders submitted a bid when the auction price met their minimum requirement. Payments were determined by cost/EB (using a modified metric; Walsh et al. 2015). In Round 2, the simplified auction format overcame some of the barriers to participation identified in Round 1 (discussed below) and led to a more community-oriented process. For example, a minimum incentive payment was known before bid submission, and householders were not required to claim the incentive as a reimbursement. Instead, project payments were made directly to a plumber (responsible for installing SCMs in accordance with local regulations). Round 2 also was characterized by more personal contact between the community and project staff. In Round 2, the final price was reached when community interest waned.

Round 3 (November 2011–October 2013; Fig. 1) differed from the cost-sharing, auction-based model of previous rounds (Table 1). Residents in priority areas were offered the full cost of installing specified SCMs, through more personal engagement approaches. The 13 priority areas were subcatchments in which: 1) no option to treat property stormwater through public SCMs was available (Burns et al. 2015), or 2) the public SCM downstream was suboptimally sized (because of space constraints). Round 3 SCMs offered to owners were optimized for environmental performance, and householders had the option to upgrade the system to suit their own objectives at their expense. Round 3 had the simplest application process. Householders were required to participate in a 45- to 60-min property appraisal and to sign a Memorandum of Understanding to accept the offer (effectively submitting their 'bid'). Offers were made only to owners of those properties on which the addition of the proposed SCM did not increase the cost/EB for its subcatchment by >20% of the final Round 2 price.

Changes between rounds in the nature and delivery of incentives were made in response to the level of community participation in previous rounds and to direct community feedback. Feedback was obtained from surveys conducted after Rounds 1 and 2 (Fig. 1), and through interviews conducted in a concurrent study (Brown et al. 2014) at the commencement of Round 2. The 2 surveys were distributed by

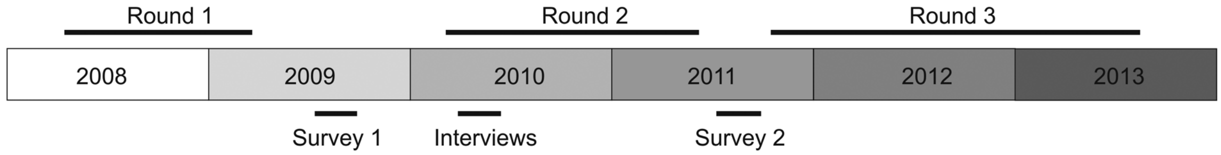

Figure 1. Project timeline showing incentive rounds, community (postal) surveys, and the community interviews conducted by Brown et al. (2014).

Table 1. Details on type of incentive offered and the environmental outcomes and cost to the project for each round. Comparisons cannot be made between the environmental benefit (EB) scores for Round 1 with those of Rounds 2 and 3 because of changes in the metric between Rounds 1 and 2 (Walsh et al. 2015). SCM = stormwater control measure, IS = impervious surface.

Round	Incentive type	Responsibilities of householders and project coordinator	Application process	Payment process	Area of IS treated by SCMs (m^2)	% of total IS	Total EB	% potential EB achieved	Cost/unit EB (AU$)	Cost/m^2 of IS treated (AU$)
1	Reverse, sealed-bid uniform-price auction	Householder designs SCM, seeks quotes for installation and prepares bids; assistance from coordinator available on request	Bid submitted by a set date, with all bids assessed collectively	Uniform price per EB with 1 payment to owner, on completion of works	13,819	70	72	37	3994	21
2	Reverse, rising-clock, uniform-price auction	Householder encouraged to accept a site visit by coordinator, allowing collaborative design of SCM and free quote from project tradesperson	Bid submitted when auction achieved the householder's minimum price	Uniform price with 2 payments: to tradesperson on completion of works, and to householder when final price determined	20,411	95	156	73	2413	18
3	Free, standardized SCM (maximum cost set by Rounds 1, 2)	Default site visit by project team (opt out available), with owner providing input into location of the SCM	Agreement form signed to accept offer	Payment made direct to tradesperson	25,789	83	210	68	3579	29

mail to householders who registered their interest in the project (by submitting an expression of interest form or contacting project staff) but did not submit a bid in that Round (nonbidders). Survey 1 was sent to 202 nonbidders and consisted of 9 questions about the quality of communication activities, the nonbidder's understanding of the auction process, and the primary reasons for deciding not to submit a bid. Survey 2 (sent to 85 nonbidders) consisted of only 2 questions about the reasons for not bidding and the engagement activities of the LSC project. In a concurrent study (Brown et al. 2014), a randomly selected group of participating and nonparticipating householders was interviewed about their experiences in Round 1, their interest in Round 2, and the reasons for their participation or nonparticipation. The interviews provided further insight into the motives of participants and the barriers and constraints to community participation.

COMMUNITY UPTAKE AND RESPONSE

Owners of 56% of properties targeted by the project registered their interest in at least 1 incentive round, but registration and participation rates differed among rounds (Table 2). The most registrations (300) were recorded in Round 1, and 183 owners registered only in that round. Twenty-eight percent of registered owners did so in multiple rounds, and half of those registrations were in Rounds 1 and 2. Despite the community's interest during Round 1, only 34% of registrants submitted a bid, of whom 53% were funded (6% of the target population; Table 2). Round 3 was the most successful (in terms of % of target population) in bids submitted (44%) and properties funded (44%; Table 2).

Fifty-four responses were received to the 1st nonbidders survey (27% response rate). Most nonbidders made little progress in preparing their bid. Sixty-five percent of respondents reported that they did not progress to the point of seeking plumbers' quotes, and 15% reported that they had attempted unsuccessfully to get quotes. Most respondents (89%) identified multiple reasons for not submitting a bid in Round 1. The most common reasons were: lack of time/too time-consuming (50% of respondents), dislike or mistrust of the upfront payments (44%), and confusion or misunderstanding about the auction process (44%). Respondents had a greater understanding of the project aims (average rating of 3.9 on a scale of 0–5) and SCMs (3.8), than they did of the auction process (2.6). Thirty-two percent of respondents reported being unsure what measures to install on their property.

Many barriers in Round 1 were overcome by an improved auction process in Round 2. Respondents to Survey 2 (n = 34, 40% response rate) were more comfortable with the auction process, and few reported difficulty in understanding the application process (3%) or the rising-price mechanism (9%). This increased understanding contributed to a greater proportion of registered householders submitting bids in Round 2 (39%) compared to Round 1 (34%; Table 2). It also may have influenced the co-investment made by properties owners because the median contribution was higher in Round 2 (AU$1837) than Round 1 (AU $462). The required co-investment was identified by 66% of respondents as the primary reason for not submitting a Round 2 bid, and the next most common reason was dislike of the suggested SCM (9%).

Round 3 was the most successful in terms of community participation and received the highest proportion of registrants (51%), bids submitted (44%), and properties funded (44%) relative to the target population (Table 2). However, Round 3 was the most expensive round. The cost to the project per m^2 of impervious surface treated (AU$29) was higher than in Rounds 1 (AU$21) and 2 (AU$18) (Table 1). This extra cost was expected because in Round 3, the expectation of householder co-investment was removed and the threshold for the project's financial contribution ($/EB) was higher. The additional cost was justified by targeting priority subcatchments. However, the environmental performance in Round 3 was lower than in Round 2 and was only 68% of the maximum possible EB score (Table 1). At the conclusion of Round 3, SCMs had been installed on 28% of the total target population (231 properties).

DISCUSSION

Community engagement in environmental programs is often discussed in academic literature from a traditional model of consultation, wherein a community's advice or opinion is sought during decision making (e.g., Sabatier et al. 2005, Karvonen 2011). Community engagement differed in our study, in that the community was asked to

Table 2. Rates of participation (registration and bidding) by targeted population for each incentive round. Target population accounts for properties treated in previous rounds and, for Round 3, considers only those properties in priority areas.

Round	Target population (P)	Registration of interest (R)		Bids submitted (B)			Properties funded		
		n	% of P	n	% of P	% of R	n	% of P	% of B
1	833	300	36%	101	12%	34%	54	6%	53%
2	779	188	24%	74	9%	39%	74	9%	100%
3	248	127	51%	109	44%	86%	109	44%	100%

participate actively in a project involving personal cost (time, money, and opportunity loss). We sought the participation of the catchment's community through education and incentives encouraging householders to actively reduce the impact of runoff from their properties on their local creek. Designing the solution (SCM) for each property required collaboration between project personnel and the householder, an approach consistent with the aims of civic politics and environmentalism (Fischer 2000, Karvonen 2011).

Measuring the success of the LSC project's engagement activities is challenging given its unique nature. Installation of SCMs on 28% of target properties is comparable to the outcome of a similar project conducted at Shepherd Creek in Ohio, USA (Green et al. 2012, Mayer et al. 2012) in which the auction used did not seek householder co-investment and the community bid for a one-off incentive payment. Moreover, during the LSC project, a number of SCMs were installed to treat road and property runoff through systems constructed by the local municipality (Burns et al. 2015, Walsh et al. 2015).

A primary benefit of the LSC project's extended engagement process was the opportunity to build community trust. Time is needed to cultivate social capital (Green et al. 2012), and the community alters its level of trust in response to the experience the engagement provides (Focht and Trachtenberg 2005). In the LSC project, Brown et al. (2014) identified that community trust was low at the outset of the project and that for many householders, trust came only after reassurance from a friend or the continued operation of the project (familiarization). Round 1 had lower rates of participation and environmental outcomes compared to subsequent rounds, but it helped build familiarity and reduce institutional distance (Lubell 2007). First-year installations in the Shepherd Creek Project also were thought to have encouraged subsequent installations (Thurston et al. 2010, Mayer et al. 2012). Development of trust over time also was critical in obtaining support from the LSC project's partners (Burns et al. 2015, Prosser et al. 2015).

The sustained effort and multiple rounds of the LSC project enabled adaptive management. Lessons and feedback obtained between rounds were used to better target the community's diverse motivations (Brown et al. 2014) and to overcome barriers to participation. Efforts should be made to identify motivations and barriers prior to a project's commencement (Pahl-Wostl 2006), but doing so can be difficult without in-depth knowledge of the community being targeted. Therefore, success in engaging a community might be improved by conducting pilot programs or surveys prior to project commencement to ensure that the various motivations and barriers are considered in the design of an engagement or incentive program. If preproject investigations are not possible, the outcomes of the LSC project indicate that an extended time frame coupled with an adaptable management strategy could benefit similar projects.

The extended timeframe of the LSC project also meant that it could accommodate changing external factors that affect individuals (e.g., family sickness, holidays) or the entire community (e.g., drought conditions, Global Financial Crisis). Drought conditions at the commencement of the LSC project were accompanied by government-imposed water restrictions (such as a prohibition of watering lawns with potable water) and encouragement of water saving. These restrictions positively influenced early registrations and made rainwater tanks attractive to residents by providing a water source not subject to restrictions. The effect of climate extremes on a community's willingness to participate in behavioral-change projects should not be underestimated, especially in light of potential climate change (e.g., Meehl et al. 2000), because it may work in favor of or against such projects.

The initial efforts of the LSC project personnel to encourage the community to install SCMs drew heavily upon education- and incentive-driven approaches to community engagement and behavioral change (Stern 1999, Agyeman and Angus 2003). These approaches have acknowledged limitations (e.g., Shove 2010, Moser and Dilling 2011), but they engendered a level of interest and participation in the project and provided a valuable platform on which to build community trust. As the project developed, the influence of informal social networks and the importance of making participation 'easy' were revealed. The education and incentive approaches were modified, drawing on the components considered successful (Stern 1999) and adding elements from community-based social marketing (McKenzie-Mohr 2013), such as personnel contact and the establishment of social norms, to develop an approach that: 1) offered a more personal interface to bridge the gap between project and community (Rhoads et al. 1999) and 2) made participation simpler, i.e., carried a lower cost (time and effort) to the community. These changes were accompanied by an increase in financial incentives, which probably were an important driver of the higher bid rate in Round 3 because financial considerations can be critical to affecting behavioral change (Brandon and Lewis 1999). However, the higher incentives of Round 3 were offered at the expense of community choice, and householders were limited to a predefined type of SCM. Unless they contributed financially, their input was restricted to decisions, such as positioning of the SCM on the property. Heiskanen et al. (2010) asserted that individuals should be involved in deciding and designing how they contribute to addressing an environmental problem. The limited flexibility in SCM choice in the LSC project could have discouraged participation by some members of the community.

The high rate of uptake in Round 3 indicates that the project was ultimately successful in terms of community engagement. Therefore, the lower environmental outcomes (i.e., % impervious area treated and % maximum EB; Table 1) in Round 3 than Round 2 were surprising, especially given the project team's increased involvement in designing the SCMs. Two explanations are offered for this. First, some of the priority subcatchments were new, higher-density neighborhoods with more constraints on SCM installation. Second, the SCMs selected by the project team for Round 3 balanced simplicity and flexibility of installation with the environmental performance and, therefore, did not perform as well as typical Round 2 SCMs.

LSC project experiences provide insights for other community-participation projects. A realistic, and where possible, extended timeframe for implementation is important. Participants need time to become familiar with and trusting of such programs. Our findings indicate that this process best occurs through more interpersonal approaches. Furthermore, the project should be flexible and use an adaptive management strategy, so it can be adjusted to accommodate changing environmental, political, and social conditions. Despite the LSC project's staged improvements to community engagement, a portion of the community remained unwilling to participate, despite generous financial incentives to do so (Hobson 2001). We suggest that leaders of behavior-change projects should have realistic expectations about the level of community participation and anticipate that a portion of the population will remain unengaged. Therefore, planners of projects that rely on voluntary participation might need to consider integration with regulatory approaches.

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