

# Education campaigns to reduce stormwater pollution in commercial areas: Do they work?

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## Abstract

A monitoring and evaluation program was undertaken, involving six different styles of evaluation to determine whether a low-cost, eight month education campaign that operated within a small commercial district was successful at changing people's behavior and reducing stormwater litter loads. This project also tested newly developed guidelines for monitoring and evaluating all types of non-structural stormwater quality best management practices (BMPs). The project evaluated: the extent and quality of the campaign's implementation; the degree to which it changed the awareness, attitudes, self-reported behavior and actual behavior of merchants and the public; and the nature of changes in stormwater litter loads. Overall, the education campaign produced mixed results, with the net result being modestly positive. Specifically, it was: unsuccessful at significantly influencing the knowledge or attitudes of merchants or the public; modestly successful at influencing the behavior of merchants and the public; and modestly successful at reducing litter loads in stormwater. At a theoretical level, the project highlights how using different 'styles' of BMP evaluation can help to build a more complete picture of a BMP's performance. At a practical level, the project helped to improve the monitoring and evaluation guidelines and produced evidence-based design guidelines for future campaigns that aim to reduce littering in commercial areas.

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## 1. Introduction

This paper presents the results of a monitoring and evaluation exercise that examined the effectiveness of a low cost, eight month education campaign that used commonly employed strategies to minimize stormwater pollution in a small commercial area of Melbourne. It provides a background to the project (including reference to the technical guidelines being tested), explains the methodology used for the monitoring and evaluation, provides a summary of how effective the education campaign was in delivering its four main objectives, provides guidance to stormwater managers who may be planning similar

campaigns in the future, and concludes by highlighting the theoretical and practical implications of the project.

### 1.1. Background to the project

#### 1.1.1. The monitoring and evaluation guidelines

In 2001 the Cooperative Research Centre for Catchment Hydrology (the CRC) began a project to research the use, value, cost and evaluation of non-structural BMPs to improve urban stormwater quality. Such BMPs include education and participation programs.

After reviewing the international literature on attempts to evaluate the performance of non-structural BMPs (see Taylor and Wong, 2002), it was apparent that:

- understanding of the effectiveness of non-structural BMPs (changes to stormwater quality or waterway health) was generally poor compared to equivalent research for structural BMPs;

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- the lack of reliable, quantified data on the life-cycle cost and value of non-structural BMPs is a major impediment to the adoption of these BMPs (NVPDC, 1996; Taylor, 2000; Brown, 1999; and US EPA, 1997);
- many different approaches and monitoring ‘tools’ have been used;
- poor evaluation design and reporting is common, especially for those studies that aim to characterize a non-structural BMP’s effect on stormwater quality and/or waterway health;
- different styles of evaluation inherently suit different types of non-structural BMPs (e.g., monitoring changes in people’s behavior is well-suited to education campaigns involving littering in public places);
- the limited resources that are available to stormwater management agencies (e.g., expertise, cash and time) often restrict the styles of evaluation that can be done for non-structural BMPs;
- little *practical* guidance material is available to stormwater managers with limited resources on how to monitor and evaluate non-structural BMPs;
- where comprehensive stormwater quality-related BMP monitoring and evaluation guidelines are available (e.g., ASCE & US EPA, 2002; US EPA, 1997; and US EPA, 2001), they are relatively complex, lengthy, focus on structural BMPs and stormwater quality monitoring, and are aimed at ‘advanced users’ (e.g., researchers and staff from large stormwater management agencies) with significant monitoring resources; and
- little sharing of data from evaluation projects of non-structural BMPs occurred across Australia, with the exception of projects involving street sweeping.

These findings confirmed the need to develop new monitoring and evaluation guidelines, which can be used by stormwater management agencies with limited resources, for all types of non-structural BMPs. Consequently, draft guidelines were developed by the CRC (Taylor and Wong, 2003). Three trial projects involving distinctly different non-structural BMPs were used to test and refine these guidelines. One of the trial projects was the Snell Grove Anti-litter Education Campaign in Oak Park, a suburb in the northwest of Melbourne, Australia.

The guidelines developed by the CRC include four main elements:

- (1) A new *evaluation framework* for all types of non-structural BMPs for urban stormwater quality improvement that includes seven different ‘styles of evaluation’. These styles cover the diversity of non-structural BMPs as well as the monitoring objectives, resources and capability of stormwater management agencies. A summary of these styles is provided in Table 1.
- (2) *Detailed guidance on choosing the most appropriate style(s) of evaluation.* This decision is a very important

one, and should be made after consideration of: the objective(s) of the BMP that will be evaluated; the resources available to the monitoring agency; the time-frame over which monitoring needs to occur; the purpose of the evaluation; and the nature of the BMP.

- (3) *Monitoring and evaluation protocols* for each style of evaluation that can be used by stormwater management agencies for all types of non-structural BMPs. The structure of these protocols has been based on the *Urban Stormwater Best Management Practice (BMP) Performance Monitoring: A Guidance Manual for Meeting the National Stormwater BMP Database Requirements* (ASCE & US EPA, 2002).
- (4) *Data recording sheets* for each monitoring and evaluation protocol to ensure that key details and results of evaluation projects are summarized and collated in a consistent manner that facilitates sharing of information, continual improvement, and the maximization of value derived from each monitoring and evaluation exercise.

#### 1.1.2. The nature of the trial

The CRC formed a partnership with the local municipal council (Moreland City Council), where Council staff agreed to design and implement an education campaign in cooperation with staff from the Moonee Ponds Creek Litter Initiative. In return, the CRC agreed to manage the monitoring and evaluation tasks, by using specialist CRC staff and social researchers. The small commercial district of Snell Grove in the suburb of Oak Park was chosen as the intervention site (see Fig. 1 for a photograph), while another commercial district in Gaffney Street in the suburb of Pascoe Vale was chosen as a suitable control site. The control site was selected on the basis of similar demographics, land use, catchment size, pedestrian traffic, rainfall, the percent of impervious area, likely litter load composition and local government management regime (e.g., management of bins, street sweeping, etc.).

Twenty-six small businesses exist in the commercial precinct of Snell Grove (e.g., take-away food shops, a medical clinic, hairdressers, etc.). The area is used by locals who travel there to shop, and by pedestrians who move through the precinct on their way to and from an adjacent railway station. The precinct includes some street furniture, public litterbins, cigarette butt bins and some basic landscaping. The approximate size of the catchment area for stormwater drains in the precinct is 9 ha.

The design of the education campaign drew upon three bodies of information. Firstly, the experience of similar campaigns in Victoria and New South Wales (e.g., Morison and Hargans, 2002). Secondly, findings of an international literature review by the CRC (i.e. Taylor and Wong, 2002) that examined the performance of non-structural measures for stormwater quality improvement (including education and participation programs). This review highlighted features of successful programs, as well

Table 1

An evaluation framework for non-structural BMPs that aim to improve urban stormwater quality (modified from Taylor and Wong, 2003)

	Style of evaluation	Description	Who typically does it	Example of monitoring 'tools'
1.	BMP implementation	Evaluation of whether the BMP has been fully implemented as designed and the quality of that implementation.	Stormwater management agencies or community groups.	Audits (e.g., checking compliance with the project plan to implement the BMP).
2.	Changes in people's awareness and/or knowledge	Evaluation of whether the BMP has increased levels of awareness and/or knowledge of a specific stormwater issue within a segment of the community.	Stormwater management agencies, often with the help of specialist community survey consultants.	Surveys (with survey forms) that examine people's level of awareness and/or knowledge.
3.	Changes in people's attitude (self-reported)	Evaluation of whether the BMP has changed people's attitudes (either towards the goal of the BMP, or towards implementing the BMP itself), as indicated through self-reporting.	As above.	Surveys (with survey forms) that examine people's self-reported attitudes.
4.	Changes in people's behavior (self-reported)	Evaluation of whether the BMP has changed people's behavior, as indicated through self-reporting.	As above.	Surveys (with survey forms) that examine people's self-reported behavior.
5.	Changes in people's behavior (actual) [particularly valid for litter-related education campaigns]	Evaluation of whether the BMP has changed people's behavior, as indicated through direct measurement (e.g., an observational approach).	Specialists (e.g., research bodies, specialist consultants, trained staff from stormwater management agencies).	Observational studies (e.g., the 'Clean Communities Assessment Tool' and the 'Disposal Behavior Index' methods used for Australian littering studies: see Curnow and Spehr, 2001 and Curnow et al., 2003) or audits with checklists (e.g., erosion and sediment control audits).
6.	Changes in stormwater quality	Evaluation of whether the BMP (or suite of BMPs) has improved stormwater quality in terms of loads and/or concentrations of pollutants.	Specialists (e.g., research bodies) or stormwater management agencies with a very high level of in-house expertise.	Stormwater quality monitoring programs (e.g., 'BACI' design experiments).  Alternatively, pollutant export <i>modeling</i> can be used to translate known changes in behavior into probable changes in stormwater quality.
7.	Changes in the health of water bodies	Evaluation of whether the BMP (or suite of BMPs) has improved the health of receiving waters.	Specialists (e.g., research bodies) or environmental protection agencies with a very high level of in-house expertise.	Ecological health monitoring programs (e.g., trend analysis).  Alternatively, receiving water quality <i>modeling</i> can be used to predict the ecological effect of known changes in stormwater quality (e.g., in estuary systems).

Notes: For advantages and disadvantages of each evaluation style, guidance on the selection of style(s), and monitoring protocols for each style, see Taylor and Wong (2003).

\*'BACI' is an acronym for an experimental design that has sampling **B**efore and **A**fter sampling at a **C**ontrol (no action) and **I**ntervention (action) site.



Fig. 1. The study location: Snell Grove, Oak Park, Melbourne (looking west).

as reporting their cost and performance. Thirdly, relevant information on people's knowledge, attitudes and behavior that was collected from the Snell Grove district by specialist social researchers (Community Change Pty Ltd) during two baseline surveys before the campaign commenced.

The objectives of the *education campaign* were to:

- Successfully communicate litter and stormwater-related messages to two target groups: merchants from the shops along Snell Grove (the primary focus); and members of the public using the area along the Snell Grove shopping strip.
- Use one-to-one, intensive and participatory methods to engage merchants (rather than just passive educational strategies).
- Raise levels of awareness and knowledge amongst merchants and the broader community with respect to littering and stormwater management.
- Reduce the rates of littering and the load of litter in urban stormwater.

The education campaign was considered a typical non-structural stormwater intervention, with elements targeting merchants and the general public. Merchant-related elements of the campaign included a brochure, one-to-one site visits and meetings with merchants, a cooperative clean-up event, a fact sheet, maintenance of infrastructure in the street (including bin-related infrastructure), posters in shop windows, windproof ash-trays and drain stenciling. Public-related elements of the campaign included posters in shop windows and a nearby railway station, stormwater drain stenciling, brochures distributed by merchants and maintenance of the local environment (e.g., clean-up of dumped rubbish and improvement to local Council-managed infrastructure). The total cost of the campaign was estimated to be AUD\$14,400 (Taylor et al., 2005) which is at the lower end of expectations for a typical, low cost non-structural campaign.

The four objectives of the *evaluation project* were to:

- (1) Determine whether the anti-litter education campaign at Snell Grove was fully implemented as set out in the project plan (and if not, determine why not).
- (2) Determine whether levels of awareness, knowledge, attitudes and behavior with respect to littering and stormwater management changed as a result of the campaign.
- (3) Determine whether loads of litter in stormwater draining from the commercial district of Snell Grove significantly decreased during and/or after the anti-litter education campaign, compared to pre-campaign litter loads (and if so, quantify the magnitude of change).
- (4) Provide a broad evaluation on the overall success of the campaign, its strengths and weaknesses, and provide recommendations for future projects of a similar nature.

The results summarized in Section 4 of this paper have been arranged to report against each of these four objectives.

## 2. Method

The methodology adopted for the trial was consistent with the CRC guidelines (Taylor and Wong, 2003). Four main activities were undertaken: planning the approach to monitoring and evaluation; choosing appropriate evaluation styles; using appropriate monitoring and evaluation protocols; and documenting the evaluation.

### 2.1. Planning the approach to monitoring and evaluation

Tasks to deliver the education campaign, as well as all monitoring, evaluation and reporting tasks, were outlined in a project plan which was prepared and refined throughout the project. This plan highlighted when each task would be done and by whom, so that people implementing and monitoring the campaign could synchronize their activities throughout the project. The seven versions of this plan also provided a 'paper trail' of how the project evolved over 2002–2004 and when each task was actually delivered.

A 'paired catchment approach' was adopted, involving undertaking several different styles of evaluation (see Section 2.2), before, during and seven months after the eight month campaign at both Snell Grove and a control site (Gaffney Street). The addition of pre-campaign monitoring that examined levels of awareness, knowledge, attitudes and behavior amongst merchants and the general public, provided a great opportunity to better understand the target audience, so that the campaign messages and delivery mechanisms could be tailored.



Table 2  
Evaluation styles used for the Snell Grove education campaign

	Evaluation style(s)*	Comments
1	BMP implementation (i.e. was the campaign fully implemented as planned and what was the quality of implementation?).	Easily monitored and evaluated after implementation of the campaign using the project plan as an audit checklist.
2, 3 & 4	Changes in awareness/knowledge (no. 2), attitude (no. 3) and self-reported behavior (no. 4) of the target audiences with respect to littering and litter prevention.	Monitored primarily using face-to-face survey instruments (targeting merchants and the public) before, during and after the campaign.
5	Changes in people's actual behavior with respect to littering and litter prevention.	Monitored primarily using: <ul style="list-style-type: none"> <li>• Observations of littering/binning (targeting the public in public places), before, during and after the campaign as part of the 'Clean Communities Assessment Tool' (Curnow and Spehr, 2003, 2004b); and</li> <li>• Inspections of small businesses.</li> </ul>
6	Stormwater quality (i.e. litter loads entering stormwater).	Monitored using side entry pit litter baskets on Snell Grove (and also a control site at Gaffney Street, Pascoe Vale), which captured gross pollutants before, during and after the campaign.

\*Note: See Table 1 and/or Taylor and Wong (2003) for an explanation of these styles. Note that evaluation style no. 7 was not used, as it was not practical given the nature of the education campaign.

## 2.2. Choosing appropriate evaluation styles

Six of the seven possible evaluation styles described in the CRC guidelines were used for the Snell Grove education campaign. These are summarized in Table 2. A large number of styles were deliberately chosen to test many dimensions of the CRC's draft monitoring and evaluation guidelines and to build a more complete picture of the campaign's effectiveness. The objectives of the education campaign and evaluation project, as well as the nature of the campaign, were the primary factors that influenced the choice of these evaluation styles.

Style 1 (monitoring BMP implementation) was necessary to get a clear understanding of the elements of the campaign that were actually delivered, the extent to which they were delivered and when. For this style, questions were answered such as: was the proposed clean-up day delivered as planned; how many people were involved; what reasons were given for attendance/non-attendance; and when did it occur? Styles 2 and 3 (monitoring awareness and attitudes) were necessary to determine whether the campaign's objectives with respect to changes in awareness and attitudes were achieved. Style 4 (monitoring self-reported behavior) was not critical, as more reliable forms of monitoring were proposed (e.g., independently monitoring people's *actual* behavior), but was added partially for academic curiosity and also because it could easily be done using the same survey instruments as needed for evaluation styles 2 and 3. Style 5 (monitoring actual behavior) was an obvious choice for a litter-related education campaign, given the campaign's objectives and the existence of well-developed methods for monitoring people's littering and binning behavior in public places (see Taylor and Wong, 2003). Style 6 (monitoring stormwater

quality) was also an obvious choice given one of the campaign's objectives was to reduce litter loads in stormwater.

## 2.3. Using appropriate monitoring and evaluation protocols

Detailed 'monitoring and evaluation plans' were prepared using the protocols and recommended actions in the CRC's monitoring and evaluation guidelines for evaluation styles 1–6. These plans were subject to peer review. The evaluation team was independent of the educators, who were solely responsible for the final design and delivery of the campaign.

### 2.3.1. Monitoring BMP implementation (style 1)

The version of the project plan that was in existence when the education campaign began was used as an audit checklist. We compared this list of actions with those actually delivered to determine whether each action was delivered, what form it was delivered in, and when it was delivered. In addition, feedback from the education officer responsible for delivering the campaign was considered in this assessment (e.g., reasons why certain elements were not delivered or were postponed), along with qualitative feedback from the target audience obtained from social surveys (i.e. from evaluation styles 2–5). We also sought verification of actions that could be independently checked (e.g., the existence of published educational products).

Assessment of the quality of the campaign's implementation was done by: comparing what is known about the design of the campaign to 'best practice' guidance from the literature (e.g., as summarized in Taylor and Wong, 2002); assessing the quality of activities and products (e.g., brochures, posters, clean-up events); and interpreting

feedback from the target audience on the campaign's design, implementation and effect that was obtained from social surveys.

### 2.3.2. Monitoring awareness, attitudes and behavior (styles 2–5)

Monitoring was conducted by staff trained in collecting data via rater assessments, face-to-face surveys and observations of behavior. It occurred prior to, during and after the campaign involving merchants and members of the public at both Snell Grove and the control site. A participatory approach was used with in-depth assessments conducted at each merchant's premises (taking between 25 and 45 min) and on-the-street surveys with the public (taking between 4 and 7 min).

One of the monitoring tools used to assess the effectiveness of the education campaign was the recently developed and validated Clean Communities Assessment Tool (CCAT), developed by Curnow and Spehr (2003, 2004b) for assessing community-related litter and littering. Accredited CCAT assessors complete three days of training that includes field experience. To be accredited, CCAT assessors have an 85% concordance rating in assessing key factors and the level of litter in an area. Assessments provide 1–5 ratings that monitor three key factor groupings that are known to influence littering behavior. These key factor groups are the: 'context' involving assessor ratings and community assessments of the sense of community, level of graffiti, domestic and commercial dumping and the general level of cleanness in a location; 'facilities' involving infrastructure including ratings of street furniture, signage, landscaping and 20 bin-related infrastructure features, such as the presentation, position, servicing and maintenance of litter bins; and 'attitudes and perceptions' of people using public spaces, including community views on 25 litter-related issues such as Council's commitment to keeping the area clean, adequacy of facilities and attitudes toward the location. CCAT assessments also included observational techniques that generated a percentage score for the positive disposal behaviors occurring in public areas (e.g., correct bin use or binning behavior), as well as litter counts and measures of dumped rubbish in the area.

A 10-point sliding scale was developed to rate the actions of merchants to prevent litter and stormwater pollution during audits of merchant premises. This rating scheme was used over the monitoring period: by independent auditors to assess behaviors at merchant premises; by the merchants as a self-assessment tool; and by the merchants to assess the performance of *other* merchants in the precinct.

Assessment procedures for evaluation styles 2–5 also gathered social data from the target audiences on a range of environmental issues, respondent awareness, knowledge, attitudes and self-reported behavior. A total of 81 surveys were conducted with merchants, and 342 with community members in Snell Grove. At the control site, 15 surveys

were conducted with merchants, and 105 with community members. For more details on the methodology associated with these styles of evaluation, see Curnow and Spehr (2004a).

The surveys examined changes to awareness, knowledge and attitudes over time in relation to many aspects such as:

- The importance placed on environmental issues in the area, with a focus on preventing littering and improving stormwater quality.
- The connection between stormwater drainage and local waterways.
- The nature of local stormwater, waste disposal and sewerage management systems.
- Local requirements for managing waste, preventing litter and protecting the quality of stormwater, particularly through reducing litter loads.
- Items and materials polluting stormwater in the precinct.
- Factors influencing littering, bin use and stormwater litter loads in the precinct.
- Environmentally responsible actions for cleaning areas in the precinct.
- The use of fines and rewards to motivate community involvement in the prevention of litter.

Data analysis for evaluation styles 2–5 included the generation of summary statistics and interpretation of trends observed in results when displayed in graphical form, but did not involve an analysis of whether any observed trends were statistically significant. In other words, subjective expert assessments were used to interpret whether observed/measured changes were 'practically significant'. As such, care was taken not to place too much weight on *subtle changes* observed during the monitoring activities for those evaluation styles (e.g., slight increases or decreases in awareness of merchants throughout the monitoring period).

Although a statistical approach to data interpretation was not used for these evaluation styles, the following strategies were adopted to increase confidence in the results:

- Use of piloting (of survey instruments and techniques), an extended baseline and follow-up period, and a control site that matched the intervention site as closely as possible.
- Use of a validated rating instrument (the Clean Communities Assessment Tool) and in-depth personal interviews involving independent, trained assessors who were able to build rapport with survey respondents (Curnow and Spehr, 2004a).
- Data analysis using different styles of evaluation to give a more comprehensive understanding of key findings and to verify self-reported information.
- Peer review of all monitoring and evaluation plans and reports.

### 2.3.3. Monitoring stormwater quality (style 6)

Monitoring for this style of evaluation also used a paired catchment approach, with the ‘study catchment’ (Snell Grove, 9 ha in size) being compared to the ‘control catchment’ (Gaffney Street, 3.7 ha in size). Monitoring of litter loads in stormwater was undertaken at each catchment, during the same period. Monitoring occurred approximately seven months prior to the campaign, during the eight month campaign, and for seven months after the campaign. During the pre-, during and post-campaign periods, seven, six and 10 litter load monitoring events occurred, respectively.

Gross pollutants in stormwater were monitored using side entry pit traps (SEPTs). The SEPTs were routinely sampled every four to six weeks or after significant rainfall events. During sampling, the trapped gross pollutants were manually removed and taken to a laboratory where they were dried, sorted and weighed.

Litter load data were summarized and graphed to identify general trends and behavior. Analysis of variance (ANOVA) with Tukey’s HSD Post-hoc Tests were used to test for significant differences in litter loads (expressed as the average mass of dry litter per day over each clean-out interval) and proportions (i.e. the proportion of litter in all captured gross pollutants, by mass) across the three monitoring periods. Analysis of variance was also undertaken for the difference between the study catchment and the control catchment, in terms of both litter loads and proportions.

## 3. Results and discussion

This section is structured using the projects’ four evaluation objectives and presents a summary of key results for all styles of evaluation.

### 3.1. Evaluation objective no. 1: Determine whether the education campaign was fully implemented as set out in the project plan

We found that approximately 50% of the actions planned immediately before the beginning of the campaign

were delivered on time, approximately 30% were delivered later than expected, and approximately 20% of planned tasks were not done. Some important activities that would have provided positive feedback to merchants (e.g., developing an incentive system and organizing positive media articles when progress was being made) and engaged non-merchant groups in participatory forms of education (e.g., school-based activities) were not delivered. Overall however, it appears that the vast majority of the planned campaign actions (approximately 80%) were implemented.

### 3.2. Evaluation objective no. 2: Determine whether levels of awareness, knowledge, attitudes and behavior with respect to littering and stormwater management changed as a result of the campaign

Summary ratings from the Community Change Assessment Tool (CCAT) shown in Fig. 2 provide a good indication of the overall effect of the education campaign in terms of changes to awareness/knowledge, attitudes and behavior. There was modest improvement in litter and stormwater management activities in the Snell Grove commercial district during the intervention, but this improvement receded approximately seven months after the campaign had finished.

The campaign did not appear to be successful at making significant and sustained improvement in the *knowledge of the community* with respect to key littering and stormwater management (e.g., knowledge relating to where stormwater drains to, whether stormwater is treated, etc.). Similarly, improvements in the knowledge of the *merchants* was inconsistent, as shown in Table 3, which highlights changes in 10 specific areas of knowledge relevant to the campaign. The results are mixed, with 70% of knowledge areas showing no clear change (i.e. less than 10% improvement in the number of merchants identifying poor practice compared to pre-campaign and control levels), 10% showing clear deterioration and 20% showing clear improvement. This modest result for merchants is surprising, given that the focus of the education campaign was on

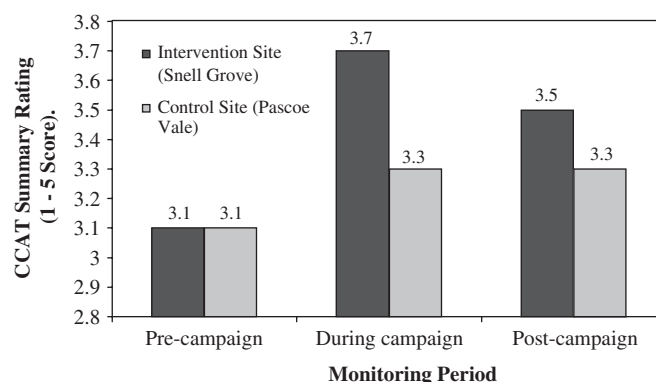


Fig. 2. Clean Communities Assessment Tool (CCAT) summary ratings.

Table 3  
Merchants' knowledge of poor practices in waste and stormwater management

	Poor practice	Snell Grove			Control site <i>n</i> = 15	Change $\geq 10\%$ compared to baseline and control?
		Pre-campaign <i>n</i> = 23 (%)	Post-campaign <i>n</i> = 17 (%)	Change (%)		
1.	Leave waste next to a bin.	93	77	–16	87	No
2.	Litter in the street or behind shop.	92	89	–3	100	No
3.	Hose footpath to clean it.	78	77	–1	81	No
4.	Store liquids that could spill into stormwater.	95	94	–1	87	No
5.	Put domestic waste in merchant litterbins.	76	77	+1	73	No
6.	Leave waste uncontained and open to weather.	80	82	+2	87	No
7.	Store waste for collection in street.	81	88	+7	93	No
8.	Put litter in street recycling bin.	58	71	+13	57	Yes
9.	Put merchant waste into street litter bin.	60	82	+22	80	No
10.	Put recyclables in street litter bin.	15	59	+58	40	Yes

the merchants and that relatively intensive, tailored, one-to-one educational strategies were adopted.

It is possible that there was an increase in *general* understanding of the scope, magnitude and complexity of stormwater quality management by the merchants, despite the mixed results relating to *specific* knowledge areas and management strategies. This would help to explain some of findings with respect to merchant attitudes (e.g., increased pessimism about the effect of stormwater management measures) and self-reported behavior (e.g., harsher self-assessment of performance after the campaign).

The campaign did not substantially change the CCAT rating relating to community attitudes. The community's attitude towards littering and litter management strategies either did not substantially change or became generally more pessimistic over the monitoring period. The attitudes of *merchants* also became more pessimistic over the monitoring period (see Fig. 3 for a selection of typical results). It appears that the campaign did not inspire or motivate many merchants, which may have been a result of the campaign not including any positive feedback mechanisms (e.g., positive incentives, rewards and/or recognition schemes) or because some of the underlying community barriers were not addressed. One positive result was that satisfaction of merchants with Council's litter management activities did substantially improve throughout the campaign, although this level of satisfaction was not fully sustained during the post-campaign monitoring period.

Using a 10-point scale, independent assessors rated the overall performance of merchants in litter, waste and stormwater management as improving by approximately 10% from the pre-campaign monitoring period to the post-campaign monitoring period at Snell Grove (see Fig. 4). In contrast to the independent ratings, the *self-assessment* ratings by merchants in Fig. 4 declined over the monitoring period at Snell Grove. This may have been due to:

- Merchants at Snell Grove becoming either slightly more aware of appropriate management practices or more confused, and therefore less inclined to rate their actions as being 'best practice' after the campaign.
- Merchants becoming generally disillusioned with the campaign and pessimistic about the likelihood of long-term change in Snell Grove, which resulted in a harsher self assessment during the post-campaign monitoring period.
- Random variation in the subjective rating (i.e. there may have been no *real* change in merchant self-assessment).

Typical merchant behavior that was assessed by other merchants also declined slightly over the monitoring period at Snell Grove (see Fig. 4). This result is likely to be indicative of no *major* changes in merchant behavior that were obvious to other merchants and frustration that a small number of merchants refused to participate in the campaign's activities or to be involved with the local precinct.



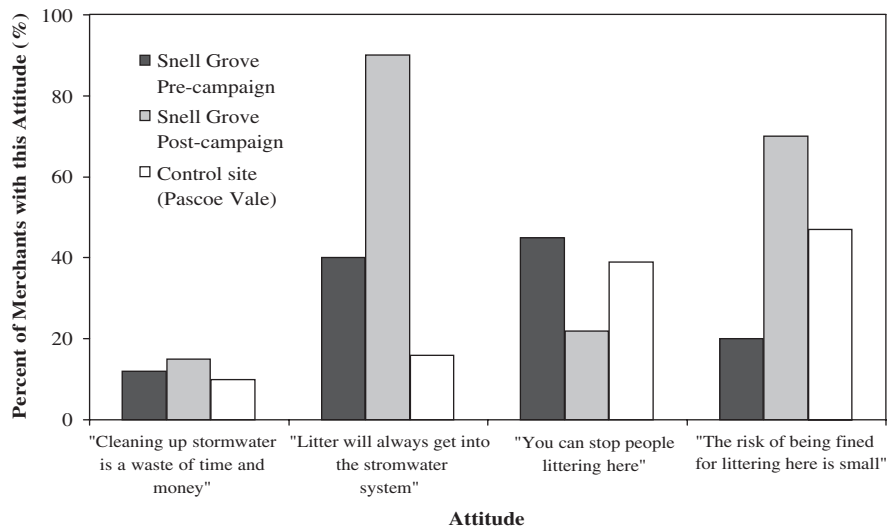


Fig. 3. Example of merchant attitudes towards litter management strategies.



Fig. 4. Assessment of merchant behavior with respect to litter and stormwater management.

Observations of people's littering and bin use behaviors at Snell Grove indicated positive disposal behavior (binning) appeared to have slightly increased (by approximately 10%) during the campaign. This improvement was sustained during the post-campaign monitoring period (see Fig. 5). It is most likely that the improvement is a result of improved bin-related infrastructure at Snell Grove (given the campaign did not substantially improve the knowledge or attitudes of the general public). Other possible explanations include:

- improvement to the amenity of the area (e.g., less illegal dumping and improved maintenance of Council-managed infrastructure) may have promoted positive disposal behavior as reported in the literature (see Curnow and Spehr, 2004b; BIEC, 1999);
- people possibly became more aware of the presence of the evaluation team and adjusted their behavior to comply with social norms; and/or
- the community may have noticed the drain stenciling, educational material distributed and displayed by the

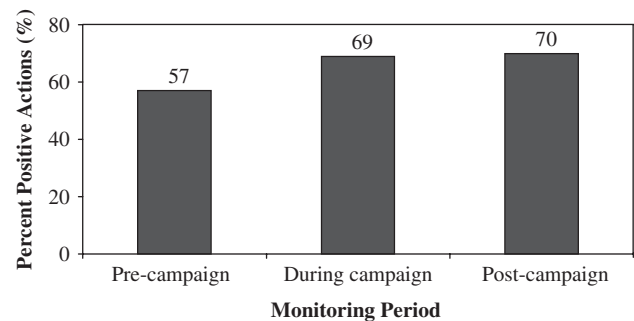


Fig. 5. Observations of community disposal actions at Snell Grove (i.e. littering and disposing of material in bins).

merchants in Snell Grove and the provision of wind-proof ashtrays by merchants and although it did not significantly improve their litter-related knowledge or attitudes, the attempt to minimise litter in the area may have encouraged some community members to dispose of litter more appropriately.

**3.3. Evaluation objective no. 3: Determine whether loads of litter in stormwater draining from the commercial district of Snell Grove significantly decreased during and/or after the campaign compared to pre-campaign litter loads (and if so, quantify the magnitude of change)**

Captured litter consisted of plastic (approximately 37% by dry mass immediately after the campaign), paper (20%), cardboard (11%), metal (10%), glass (8%), tobacco products (5%), commercial wastes (3%) and foil (2%). For more details, see Taylor et al. (2005).

When data from both the intervention and control sites are analyzed together, the litter load monitoring results suggest that the education campaign *probably* reduced litter loads at Snell Grove, despite increases in the total load of gross pollutants over time, due to other influences such as seasonal variations in leaf-fall and rainfall intensity. However, the education campaign's effect appears to be relatively weak resulting in subtle effects on stormwater quality, few of which are statistically significant.

In terms of quantifying the likely reduction in litter loads, at best the data indicate that the time-weighted average litter mass (kg/day) over the pre- to post-campaign monitoring periods at Snell Grove increased by approximately 17%, while at the control site it increased by approximately 94% (see Fig. 6). Consequently the *relative* reduction in litter load at Snell Grove compared to the control site over these monitoring periods was approximately 77%. This result was not, however, statistically significant (ANOVA,  $p = 0.34$ ).

The difference between sites in terms of the proportion of gross pollutants made up by litter was also investigated. The results indicate that at Snell Grove, the proportion of gross pollutants made up by litter decreased during the pre- to post-campaign monitoring periods by a greater amount than occurred at the control site. Specifically, at Snell Grove the percent of litter in the total gross pollutant load (kg/day) over the pre- to post-campaign monitoring periods decreased by 5.5 times the decrease observed at the control site (i.e. Snell Grove reduced by 44%, while the

control site only reduced by 6.7%). This relative change over time was weakly significant (ANOVA,  $p = 0.09$ ).

Overall, the results of the stormwater monitoring suggest that the education campaign had a *moderate* positive effect in reducing litter loads from the catchment, when compared with the control catchment. However, the relatively low degree of statistical confidence in these findings may be due to the limited number of rainfall events that could be sampled over the monitoring periods (i.e. seven sampling events before the campaign, six events during the campaign, and 10 events after the campaign). Whilst this was a substantial monitoring effort, it is still a relatively small dataset and thus prone to the effects of variations in rainfall, wind, season differences (e.g., leaf-fall), etc. The low degree of confidence in the results may also be influenced by the intensity and/or quality of the education campaign at Snell Grove, relative to that needed to achieve a substantial and sustained reduction in litter loads in stormwater.

**3.4. Evaluation objective no. 4: Provide a broad evaluation on the overall success of the campaign, its strengths and weaknesses, and provide recommendations for future projects of a similar nature**

Overall, we conclude that the anti-litter education campaign at Snell Grove produced mixed results, with the net result being only modestly positive. Specifically, it was: unsuccessful at significantly influencing the knowledge or attitudes of merchants or the public; modestly successful at influencing the behavior of merchants and the public; and modestly successful at reducing litter loads in stormwater.

It is enlightening to compare these results to what is known about the effects of similar campaigns that have been reported in the literature. For example, after reviewing the literature on stormwater-related educational campaigns, Taylor and Wong (2002) concluded that six to 12 month education campaigns in commercial/industrial precincts that involved the provision of educational media

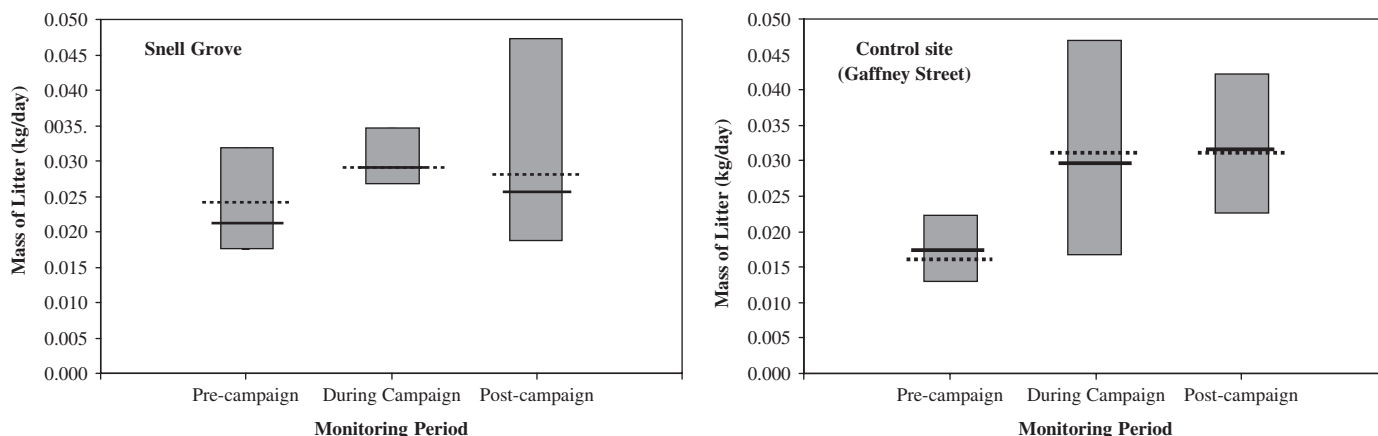


Fig. 6. Mass of litter collected in stormwater at Snell Grove and the control site (box: inter-quartile range; solid line: median; dotted line: average).

and use of one-to-one discussions appeared to be capable of delivering:

- “5–15% (with an average of the most reliable data around 12%) increase in knowledge/awareness (industrial programs). [That is, 5%–15% of the surveyed population increased their knowledge in a certain area relating to the campaign.]
- Mixed-to-negative results for programs involving commercial food retail outlets (i.e. for attitudes and knowledge/awareness).
- 58% increase in the number of people undertaking at least one desirable behavior (commercial/industrial programs).
- 26–40% increase in the number of people undertaking a specific type of desirable behavior (commercial/industrial programs).” (p. 69, text in square parentheses has been added).

Interestingly, the Snell Grove educational campaign involved some commercial food retail outlets and like the studies summarized by Taylor and Wong (2002), also found no significant increase in the stormwater-related attitudes or awareness of merchants. The campaign also produced some improvements in behavior, albeit to a lesser extent compared to those reported in the literature.

Based on relevant information from the literature on best practice educational campaigns involving stormwater management (e.g., Curnow and Crispijn, 2005; Curnow et al., 2003; BIEC, 1999; and Taylor and Wong, 2002), identified strengths and weaknesses of the education campaign at Snell Grove, and knowledge about the on-the-ground outcomes produced from the campaign, the *primary recommendation* for future campaigns is as follows:

To get a substantial reduction in litter loads entering stormwater, significant human resources are needed to make the campaign:

- ongoing;
- participatory (rather than using passive education strategies like posters and drain stenciling);
- balanced (i.e. target merchants and the community with equal intensity);
- inspirational and motivational (e.g., by recognizing positive achievements and rewarding such behavior);
- compelling, with clear links to known motivators (e.g., a combination of education and financial incentives/penalties has been found to be essential for effective erosion and sediment control programs—see Lehner et al. (1999) and Taylor and Wong (2002));
- responsive and flexible so it can quickly adapt to new information (i.e. using monitoring and evaluation mechanisms to provide feedback before and during the campaign on whether knowledge, attitudes and/or behavior are changing as desired);
- tailored to accommodate known local characteristics (e.g., the social and physical environment) as well as commitments and work schedules of participants; and
- multi-dimensional (i.e. include strong incentives/rewards, penalties, provision of high quality bin-related infrastructure and associated maintenance, provision of a high level of maintenance activities to improve people’s pride in their local community, provision of regulatory services to stop illegal activities and encourage involvement in the precinct, etc.) and complete (i.e. include all of these elements).

Considerable staff time is needed to design and execute education programs of this nature, particularly if they are to be ongoing and adaptive. During the program at Snell Grove, merchants changed their preferred method of communication from written materials to face-to-face meetings with education officers. Such meetings take considerable time and effort to deliver, given limited opportunities to spend time with busy merchants (i.e. re-scheduling and multiple visits are typically needed, with some visits being outside of business hours). Educator time is also needed to build relationships, communication and trust with merchants to enable educators to respond to *other* issues that emerge (e.g., the need to enforce specific local laws on illegal activities that may not be litter-related but reduce the social capital of the precinct). Educators need organizational support and planning to ensure that these resources will be available so that momentum is maintained and the target audience remains committed and motivated toward the main objective.

#### 4. Conclusions

This paper contains three key messages. Firstly, we found that a low cost, eight month education campaign that used commonly employed strategies to minimize stormwater pollution in a small commercial area of Melbourne produced mixed results, with the net result being only modestly positive. Specifically, it was: unsuccessful at significantly influencing the knowledge or attitudes of merchants or the public; modestly successful at influencing the behavior of merchants and the public; and modestly successful at reducing litter loads.

Secondly, we found that taking a *multifaceted* approach to monitoring and evaluation, where different elements of the program’s performance are jointly evaluated (e.g., changes in people’s awareness and behavior, and well as stormwater quality) enables the evaluation team to form a comprehensive picture of what happened and why. Guidelines have been developed for monitoring and evaluating *all types* of non-structural stormwater quality best management practices (non-structural BMPs) that include seven alternative styles of the evaluation to help facilitate this approach.

Finally, knowledge developed through the multifaceted monitoring and evaluation program in Melbourne enabled

us to develop design guidelines for those stormwater managers who are planning education campaigns in the future for commercial districts.

The project also provided a good opportunity to trial, refine and finalize new guidelines on monitoring and evaluating all types of non-structural measures for stormwater quality improvement (Taylor and Wong, 2003). The trial led to new recommendations in the guidelines, such as:

- the importance of having clear organizational responsibilities for managing a project and its implementation, including a detailed and regularly updated project plan to synchronize and coordinate activities involving both the monitoring and implementation of the non-structural stormwater management measure;
- the value of taking a paired catchment approach to monitoring (i.e. using a control site) to increase the explanatory power of monitoring results;
- the value of taking a statistical and multifaceted approach when seeking to determine subtle changes in monitoring parameters; and
- the value of using information collected during pre-campaign monitoring (e.g., on the target audience's knowledge, attitudes and behavior) when designing education campaigns.

From a theoretical perspective, the Snell Grove project highlighted that monitoring the effectiveness of non-structural measures (such as education campaigns) for stormwater quality improvement can be complex, particularly when their influence appears to be subtle. The use of several different evaluation 'styles' (e.g., determining whether the campaign: was delivered as planned; changed people's knowledge and attitudes; changed people's behavior; and improved stormwater quality) helped to overcome this complexity and generate understanding of the measure's performance.

From a practical perspective, the project has produced two bodies of information that can be used by urban stormwater managers. These are: the guidelines for monitoring and evaluating *all types* of non-structural stormwater quality measures (Taylor and Wong, 2003); and practical design guidelines for creating more effective education campaigns to minimise littering in commercial areas.

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