

Reducing Nonpoint Pollution with Public Outreach / Education Programs

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Abstract

It has long been assumed that outreach programs directed at changing the behavior of residential property owners can have an impact on reducing nonpoint pollution associated with such activities as: lawn and garden care, car care, and disposal of yard wastes and household chemicals. From 1992 through 1997, Prince George's County, Maryland's Department of Environmental Resources (PGDER) conducted a comprehensive public education program to test this assumption. PGDER's program attempted to measure the effectiveness of outreach efforts in three ways: (1) through before and after program surveys, (2) by using a water quality modeling assessment tool and, (3) by monitoring the water quality of the receiving waters before and after the outreach program. The findings indicate that the effectiveness of an outreach program depends greatly on three things: (1) the level of funding available to sustain efforts on a long-term basis, (2) the types of outreach venues used, and (3) tailoring outreach programs to address unique issues and socioeconomic factors in the target community.

It was found that even with the intensive educational effort of this program, lasting over one year, the degree of change was marginal. The cost of a multifaceted targeted education program was far greater than anticipated, and cost prohibited implementation of the program on a countywide basis. Quantifying and understanding the fate and transport of urban pollutants and the effectiveness of the outreach efforts proved to be both complex and difficult.

I. Background

In 1992, Prince George's County, Maryland's Department of Environmental Resources (PGDER) received a 319 grant from the State of Maryland's Department of the Environment to conduct a comprehensive public outreach program in a small residential community named Kettering. Kettering is a middle-income, white-collar, medium density (1/4-acre lots) residential community with 1,125 units covering about 380 acres. Kettering was developed in the early 1970s with no stormwater quantity or quality controls. The total population of the community is approximately 2,800 residents. Baseline water quality data indicated degradation of the receiving stream's water quality from nonpoint sources (e.g., elevated levels of nitrogen, phosphorus, and heavy metals).

in the development of future outreach programs for residential communities. One fulltime project manager was assigned to the program to effectively coordinate all aspects of the program's planning and implementation. Since we wanted to learn as much as we could about developing effective outreach efforts, the program was designed to be very comprehensive, covering many topics and using numerous educational methods and tools.

The intent was to localize the program by encouraging residents to take ownership and understand that improving the waters of Kettering was linked to improving the quality of life in their community. The benefits and impacts that we highlighted were: a cleaner, healthier neighborhood with less harmful chemicals, aesthetic improvements that may increase property values, and saving time and money.

Twelve educational topics were chosen. For each topic, the residents were shown how they could directly benefit by changing their behavior. Our approach was to spend an entire month on each topic, so as not to overwhelm the residents with too much information on a variety of topics all at once. To insure that the most residents possible heard the message, a variety of outreach tools were used. Each month, every home received a mailing that included a cover

II. Outreach Approach and

Philosophy

This outreach / education program was designed as a leaning tool and to be the cornerstone for the county

letter and all enclosures important for the month's topic. In addition, an article was printed each month in the local newsletter, "The Olde Mill News." The article covered the issue of the month and updated the residents on significant milestones. The newsletter has a circulation of about 1,200 throughout Kettering. Displays, flyers, and workshops were also used, when needed, for specific issues and topics.

A colorful, distinctive letterhead was designed specifically for this project so that the mailings would immediately be recognized. We found out later from the community that our letterhead was indeed a big attention getter.

Another goal of the participation efforts was to include a large number of community participants, through a variety of means, to help with education efforts. This included setting up an Environmental Advisory Committee composed of community activists and leaders, working with scout troops in a variety of environmental activities—such as adopting the stream and wetlands, and involving the local school students in environmental enhancement projects (tree planting and stream monitoring) on their school grounds.

Establishing the advisory committee helped convince the residents that this was their project, more than a county, state, or federal project. It was believed that if the community viewed the county efforts as an imposition from above, it might foster a sense of apathy and complacency, or worse, a sense of resentment. Creating a feeling that the success or failure of the project relied heavily on the community would help the residents see the importance of local action. The residents knew that the more they helped with the project, the more benefits the community could receive.

III. Community Activity and Issue Assessments and Characterization

Before the public outreach program could be developed, it was necessary to identify and understand unique issues and problems in the Kettering community. Several key reconnaissance activities were conducted to characterize the community. These activities are described below.

1. Televising Storm Drains

Prior to initiation of the program, the entire storm drain system was televised to look for illegal discharges, connections, and problems. Several illegal

connections and discharges were discovered. Two were from a small commercial development in the watershed and were discharges associated with restaurants. Floor drains were connected to the storm drainage system. These drains were routinely used to dispose of food wastes, grease, and cleaning chemicals. One illegal connection was from a large backyard kennel operation. Animal waste, trash, and debris had been flushed into the storm drain system on a daily basis for about 20 years. The storm drain serving this kennel was partially blocked with these wastes. In an area of the subdivision under constitution, the storm drain was partially filled with sediment due to poor maintenance of sediment control devices. Appropriate enforcement actions were taken to correct these activities.

Also noted occasionally throughout the systems were piles of debris, yard waste, and trash resulting from illegal dumping. We also found a number of poorly constructed field connections where sediment was washing into the pipe system.

2. Community Windshield Tour

It was important that the staff working on the project get to know the community on an intimate basis. Several teams drove and walked through the entire community to identify unique problems and typical homeowner activities that should be targeted. This included also understanding social and economic issues or barriers (language, income, education, cultural, community standards, etc.). Other activities were noted, such as level of property maintenance, importance of landscaping, car care, erosion problems, drainage problems, use of professional lawn services, number of abandoned cars, etc. All of the information gathered was used to craft the initial survey and to design the educational program.

3. Community Institutions

All community institutions and groups that could play a role (problem identification or program participation) were identified and contacted about the project. These included schools, churches, libraries, sport clubs, and community organizations. In every case, we found all of the institutions to be extremely cooperative and helpful—volunteering their services, facilities, and even money to help in the outreach efforts.

4. Pre-Outreach Program Survey

The initial public survey questions were based on the community characterization work described above. The survey was given to all 1,125 single-family property owners in the Kettering project area. The purposes of the survey included: (1) to measure the level of environmental awareness of the community

residents; (2) to determine the extent to which community residents engaged in daily activities affecting nonpoint source pollution; (3) to determine how the community perceived the project; (4) to help identify the target audience; and (5) to identify special issues and key motivators. All survey questions and results of the first and second questions are shown in the attachments.

5. Pre-Outreach Program Results

Out of 1,125 households mailed a survey, 403 (36%) of the responses were returned. This response rate was quite high compared to other public survey efforts by PGDER. This high response rate was due, in part, to the extensive preprogram publicity and outreach efforts by the PGDER staff, elected officials, and other partners in the program. Due to the large response rate, it was assumed that the results were representative of the community as a whole. However, it must be noted that 64% of the households did not respond, which could suggest that most of the community was unmotivated to participate in this effort. A few of the findings are discussed below.

A. General Knowledge and Participation

The initial public survey results revealed that Kettering residents lacked a general knowledge and awareness of basic nonpoint source water quality issues. 58% of the residents did not know that storm water runoff from residential neighborhoods causes water pollution problems. An alarming 72% of the Kettering residents did not know how to report illegal dumping or other pollution problems to local officials. The participation levels in various widely publicized county environmental programs were also low. Although 72% of the residents were aware of the county's household hazardous waste collection program, only 38% of the residents used it.

B. Automobile Care

The initial survey responses on residential automobile care provided considerable insight into the pollution potential of this type of activity. Approximately 31% of the residents change their own car oil. The survey showed that an overwhelming 90% of the residents who change their own oil recycle it. However, 10% of the used oil is still being disposed of improperly. Similarly, 25% of the residents change their own antifreeze.

C. Lawn Care

Survey results showed that approximately 87% of all of the residents apply fertilizers to their lawn, and 80% use pesticides. In spite of these efforts,

approximately 49% were still not satisfied with the appearance of their lawn.

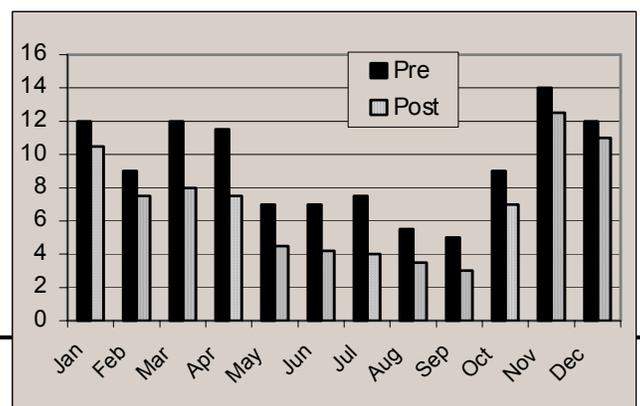
The majority of fertilizer applications occur in the spring and fall, although some apparently apply it all year long. Applying fertilizers in the spring can increase irrigation needs, mowing requirements, and may weaken grass roots. The Maryland Cooperative Extension Service had developed an environmentally sensitive, low cost lawn care program, which recommended restricting fertilizer applications to the fall. Only 11% of the Kettering homeowners followed this fertilizer application program. The Extension Services' program was adopted as the recommended program for this educational component on lawn care.

6. Water Quality Modeling

Predictions as to the effectiveness of the educational program were developed using the HSPF continuous simulation water quality model (EPA 1983). The modeling effort was focused on nutrient reductions in residential areas based on anticipated benefits from the recommended lawn care educational programs. Due to seasonal application interests and the importance of storm size and hydrology on nutrient wash-off, a continuous simulation model was selected to provide insight on the potential benefits of the public education program. Specific benefits evaluated with the model include reductions in application rates and shifting application periods from spring to fall.

The data generated from the model were used to make informed decisions regarding how water quality improvement programs should be tailored for this particular community to be most effective. The detailed description of the modeling work is not described in this paper. It is outlined in an unpublished paper by Jennifer Smith titled "Public Survey and Pollutant Model for Prince George's County, 1994." An example of the types of HSPF modeling outputs is shown below in Figure 1.

The modeling efforts assumed a 70% participation rate in the recommended lawn care program. The results indicate that one could expect to see an annual loading reduction of 19% in nitrogen and a 76% in phosphorus, as well as about a 40% reduction in nitrogen in the spring time months. One important finding with the modeling was that we could see the



effects of shifting fertilizer application activities from spring to fall. By shifting fertilizer application to the fall, reductions in pollutants during critical spawning times could be seen. Seasonal reductions in nitrogen, phosphorus, or other pollutants could yield significant ecological benefits.

Figure 1. Mean Monthly Nitrogen Concentration

(Est. from HSPF for 8-year simulation)

IV. Development and Implementation of the Education Programs

Based on the survey results and the community characterization work the final educational programs were developed on the themes shown below.

- Household Hazardous Wastes
- Recycling
- Lawn Care (testing, fertilizer, pesticides, herbicides, and erosion)
- Car Care (washing, oil, antifreeze, and chemicals)
- Spills and Dumping (reporting and prevention)
- Swimming Pool Discharges
- Yard Wastes Disposal and Composting
- Back Yard Habitat Creation
- Animal Waste
- Landscaping for Water Quality
- Volunteer Stream Monitoring (biological)
- Community Clean Up Programs

These educational topics were presented to the community over the course of a year using a wide variety of outreach methods. The methods included workshops, community meetings, community day displays, flyers, community newsletters, direct mail, and brochures. Some educational topics (lawn care, car care, landscaping, composting, recycling, and volunteer monitoring) received the full complement of educational techniques; other topics used only some of the outreach techniques. The education program took place from June of 1992 through June of 1993; one education topic was covered each month. There was no follow-up educational program thereafter.

V. Post Program Survey Results

Three months after the completion of the one-year educational program, the second post program survey was mailed to the same 1,125 households. The questions were essentially the same. One thing noted was 5% of residents had moved during the 16-

month period between surveys (based on the number of surveys returned unopened due to incorrect names). The response rate was only 15% compared to the first survey response rate of 36%. Further, we did not check to see if those responding to the first survey were the same as those responding to the second survey. Different residents responding to the first and second surveys could account for some of the anomalies in the survey findings.

The survey indicated that 94% of the respondents would adopt the pollution reduction programs proposed by the county. However, this overwhelming support or willingness to adopt the environmentally friendly programs was not supported by the comparison of the two survey results. For example, the educational lawn care program recommended that lawns only be fertilized in the fall using 1/3 the recommended rate. The responses in the two surveys show essentially no change in the seasonal application of fertilizer, with equal applications in spring and fall. The lawn care program recommended a reduction in the use of herbicides and pesticides. The second survey showed no change in the use of herbicides and an increase in the use of pesticides.

There were some changes in the survey responses that were very positive, such as an increase in the number of people that believe urban storm water does cause problems. There was also an increase in the number of people that recycle oil and know how to report illegal pollution problems.

The survey findings did not correlate well with the modeling results; given the anomalies in the comparison of the two, no further modeling was attempted using the pre- and post-program survey findings. We decided to wait for the water quality monitoring results before additional modeling was conducted.

VI. Water Quality Monitoring

The program involved a long-term monitoring component. Receiving water quality data were collected during pre-program conditions in 1992 and 1993 and post-program conditions in 1996 and 1997, three years after the conclusion of the outreach program. The delay in the monitoring was to allow for the completion of other watershed restoration projects, such as wetland construction, and for reforestation to be completed and stabilized. These structural components were down stream from the outfall of the residential community where the public outreach efforts were focused. The pollutants monitored included Pb, Zn, NH₃, BOD, NO₃/NO₂, TP, TKN and TSS. ISCO automated samplers were used, and the event mean concentrations were calculated.

The chart below shows the findings of the water quality data. Many of the post-program pollutants increased.

It is interesting to note that the median NO_3/NO_2 level dropped by 42% (also predicted in the model) and the median TP level dropped 31% (highlighted in Figure 2). This drop is most likely the result of the education program to reduce the use of fertilizer, but this is not confirmed by the survey results that indicate little change in the use of fertilizer or timing of fertilizer application.

Figure 2. Comparison of Pre / Post Program Water Quality EMC's

Pollutant	Pre Program			Post Program		
	Min	Max	Median	Min	Max	Median
Lead	6	26.1	11	3.8	107.7	10.7
Zinc	30.1	377	60	25.2	357.7	41.4
NH ₃	ND	1.1	ND	0.06	0.51	0.12
BOD	3.7	32.7	5.5	2.46	34.09	10.44
NO ₃ /NO ₂	0.22	0.89	0.45	0.09	0.47	0.26
TP	0.2	0.87	0.45	0.07	1.01	0.31
TKN	ND	4.8	1.6	0.56	3.43	1.16
TSS	15.4	115.5	45	28	346	93

VII. Outreach Costs

Figure 3 below summarizes the outreach program costs. It was clear as the outreach program was being planned that the development and implementation of a comprehensive and aggressive education program would be extremely labor intensive. Planning, development, and coordination of the various program components took the full-time effort of a dedicated person. This work was supplement by many individuals that assisted in carrying out each program element. For example, the reconnaissance study required four people working for two weeks to fully complete and develop recommendations. The six workshops conducted required the expertise of other staff and local professionals to develop and implement. The total program cost worked out to be about \$84,000. This covered staff time for all phases of the program planning and implementation.

Figure 3. Summary of Outreach Program Costs

Program Planning (staff)	\$ 2,100.00
Reconnaissance (staff)	\$ 6,512.00
Televise Stormdrains (contract)	\$ 10,000.00
Project Management (staff)	\$ 45,619.00
Workshops (staff & materials)	\$ 4,644.00
Publications (direct)	\$ 4,852.00
Mailing (direct)	\$ 7,818.00
Other Support (staff)	\$ 2,150.00
Total	\$ 83,695.00

From these direct costs, one can estimate the cost of conducting a similar comprehensive education program on a countywide basis. The cost of this

program per residential unit (1,125) is about \$75. The County has about 250,000 single-family units. Based on the Kettering costs, a program of the same nature and level of intensity would cost approximately \$18,750,000. Obviously, this would be cost prohibited.

However, we did note in the initial survey results that most people followed fertilizer application rates on the product label. Based on this, a much more cost effective way to reduce the use of fertilizers would be to encourage manufactures to change their recommendations to read, "use 1/3 less and only fertilize in the fall." Of course, this is not likely, as it would have significant impacts on sales and profits.

VIII. Conclusions

The Kettering project allowed PGDER to develop a better understanding of the complexities, costs, and level of work required to develop outreach programs for nonpoint pollution associated with residential communities. Outreach is not easy and more costly and labor intensive than ever imagined. Although the survey results indicate an overwhelming willingness by the property owners to adopt more environmentally sensitive activities, the survey results did not demonstrate a significant change in targeted activities as a result of this program's outreach efforts. However, the water quality monitoring data did indicate that the median EMC of nitrogen and phosphorus was reduced following the completion of the outreach program. However, it is not entirely clear that this reduction was directly related to the outreach efforts; the reduction could have been associated with variations in rainfall or runoff patterns and intensities.

The study led us to believe that outreach efforts targeted at manufactures of lawn and car care products, as well as lawn care service providers may potentially be more cost effective in reducing nonpoint pollution than direct outreach programs focused on the end users. One of the survey findings showed that most people got their information on the use of chemicals from product labels. If this is the major source of information for homeowners, it would make sense to work with manufactures to provide labels that include an environmentally friendly option (e.g., use less and only once per year in the fall).

It was also clear that the approach taken in this program was not as effective as anticipated. For a direct educational program to be effective, we now believe that it must be intense and sustained. The survey found that property ownership turnover was about 5% per year. Therefore, in just a few years a majority of the property owners will be new and uneducated. The recycling experience has shown that

effective, successful public education must be multifaceted with a long-term commitment.

The direct mail survey did not seem to be an effective way to measure changes in behavior. Perhaps, it was PGDER's lack of experience in developing effective surveys that was at fault. The survey may have been a more effective tool if the information had been gathered through door to door interviews. The survey did, however, give us tremendous insight into the use of fertilizers, values of the community, level of knowledge, environmental interests, motivational factors, and the magnitude of the problems associated with nonpoint pollution in an urban setting.

We felt the community characterization work was extremely helpful in the development of effective outreach materials targeted to unique problems in the community. Subsequent to the Kettering study, we did conduct another residential outreach program in Seat Pleasant which is a blue-collar community. We found the problems in this community to be totally different. In Seat Pleasant, few, if any, homeowners fertilize their yards, but almost everyone repairs and maintains their own cars. Needless to say, illegal dumping of oil, antifreeze, and gasoline were the major problems. Many of the inlets in the neighborhoods were routinely used to dispose of oil.

The impact the Kettering project on our current outreach efforts was immense. What developed from the Kettering program was our "Streams Teams" program. One of the more successful parts of the

Kettering project was the terrific cooperation and interest expressed by community groups and institutions. The Streams Teams program is a voluntary stream monitoring and adoption program that also incorporates all of the educational programs developed in the Kettering project. Streams Teams focuses on educating community groups, schools, scouts, homeowner associations, as well as community watershed and environmental organizations.

Another consequence of the Kettering project was that it caused us to rethink our overall approach and philosophy towards controlling urban storm water. Since this project only resulted in marginal changes in behavior, this encouraged us to begin to look at other options to outreach. It was noted during the project that if residential yards had a greater capacity to assimilate nutrients and generated less runoff, it might not be necessary to change homeowner's behavior at all. If residential communities were designed with disconnected impervious surfaces and used open drainage systems, multifunctional landscaping, rain gardens / bioretention, more infiltration, and amended soils (deep tillage and added organic materials), the urban landscape would be able to capture, assimilate, and cycle more pollutants. This project provided the impetus to further explore the development of the PGDER's Low Impact Design Technology to modify a subdivision's design in ways to significantly reduce runoff and nonpoint pollution by creating a more ecologically functional landscape.

IX. Attachments

Kettering Public Survey Results

Activity	Survey (%):	
	2nd *	1st
<i>Total Response Rate</i>	15	36
Will Adopt Environmental Protection Programs	94	NA
Do Not Know SW Runoff Causes Pollution	40	58
Do Not Know How To Report Pollution Problems	55	72
Do Not Participate In County Recycling	2	13
Do Not Use Household Hazardous Waste Program	4	62
Do Not Recycle Used Oil	0	10
Do Not Recycle Antifreeze	15	NA
Change Own Antifreeze	24	25
Use Car Wash	37	29
Wash Car Weekly	19	24
Wash Car Monthly	33	39
Wash Car 2X/Year	26	23
Wash Car Yearly	6	4
Fertilize Own Lawn In Spring	46	43
Fertilize Own Lawn In Summer	9	10
Fertilize Own Lawn In Fall	44	40
Fertilize Own Lawn In Winter	8	7
Use Herbicides	56	30
Use Insecticides	41	42
Use Fungicides	22	15

* Percentage is to number of respondents

** Percentage of those who change their own antifreeze

Survey Questions

Kettering Community Demonstration Project Survey Two

This survey is being conducted by the Prince George's County Department of Environmental Resources to evaluate the effectiveness of the environmental education program. Should you have any questions, please contact Stephen Paul, Public Education Coordinator, at 925-7168.

Please answer each question by circling the appropriate response.

1. Did you return the first survey that was mailed to you last summer? Yes / No
2. Do you think that you will adopt our environmental protection programs? Yes / Very Likely / Likely / No
3. Do you believe that neighborhoods like Kettering cause water pollution problems in nearby streams?
Yes / No / Do Not Know
4. How did you hear about our environmental education programs?
Mail / Newsletter / Workshop / Library / Neighbor / Other, Please Specify:
5. Do you change your own car oil? Yes / No
6. If yes, do you take the used oil to a gas station or recycling center? Yes / No
7. Do you change your own antifreeze? Yes / No
8. If yes, do you take the used antifreeze to a gas station or recycling center? Yes / No
9. How often do you wash your car yourself? Weekly / Monthly / Twice Per Year / Once Per Year / Never
10. When you wash your car, will you do any of the following? (Circle all appropriate answers.)
A. Use a biodegradable and non-toxic detergent; B. Divert the wash water onto the lawn; C. Use less detergent; D. Use less water; E. Take it to a commercial car wash; F. None
11. Are you aware of the County's Household Hazardous Waste Collection program? Yes / No
12. Will you use the County's Household Hazardous Waste Collection program? Yes / No
13. Do you participate in the County's recycling program? Yes / No / Sometimes
14. Do you know how to report illegal dumping? Yes / No
15. When making landscape improvements to your yard, will you consider water quality and wildlife habitat features in your plan? Yes / No
16. Do you currently have or will you add any of these wildlife habitat features in your yard? (Circle all appropriate answers.) Bird House / Bat House / Wild Flower Meadows / Bird Bath / Brush Piles / Hedge Rows / Bird Feeder / Small Pond / Mature Trees / Berry Producing Shrubs
17. How would you rate the environmental education program? Excellent / Good / Fair / Poor / No Opinion
18. Do you have any other comments?