Effectiveness of Public Education and Outreach Programs for Reducing Impacts of Stormwater on Rivers and Streams

Prepared by
Leska S. Fore
Statistical Design
Seattle, WA

Prepared for
The Stormwater Work Group, Puget Sound Ecosystem Monitoring Program,
Washington Department of Ecology, and
The Association of Washington Cities

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Key Findings

- Many people in Puget Sound are very aware of stormwater issues and how they relate to the health of Puget Sound. Many are willing to do more and pay more to protect the Sound.
- Public education and behavior change programs work: behaviors can be changed and pollutants can be reduced.
- Increased awareness of an issue does not necessarily lead to a positive change in behavior; nonetheless, awareness may be a prerequisite for a successful behavior change program.
- Behavior change programs are more successful when they target specific behaviors and audiences.
- Studies are more likely to measure whether behavior has changed rather than whether the health of the water body has improved.
- The Puget Sound Partnership and King County have developed and tested indexes to identify target audiences and measure behavior change at a regional and local scale.

Context for this Document

The Washington Municipal Stormwater Permits for Phase 1 and 2 jurisdictions require an education and outreach program that targets specific audiences to change polluting behaviors associated with, for example, yard care, storage of chemicals, pet waste, auto maintenance, and prevention of illicit discharges (Department of Ecology, 2012a,b).

The Stormwater Work Group (SWG) is a group of stakeholders representing local, state, and federal governments, environmental and business organizations, tribes, and agriculture. The goal of the Work Group is to reduce the harm caused by stormwater to the Puget Sound ecosystem. The SWG's Regional Stormwater Monitoring Program (RSMP) will be implemented through municipal stormwater permits.

During 2011-2012, the Stormwater Work Group identified 22 questions about the effectiveness of various stormwater management practices for reducing the impact of stormwater on water resources. To answer these questions, the Stormwater Work Group commissioned a series of literature reviews to evaluate which of those questions have already been answered. The purpose of this document is to provide just enough context in order to answer and evaluate the questions asked by the SWG. This document addresses 4 of the 22 effectiveness monitoring questions related to public education and outreach (See Appendix 1 for complete list of questions).

This document includes:

1) A description of how social marketing principles are used in public education and outreach;
2) Results from local surveys and research to answer the specific questions from the Stormwater Work Group about whether public education can reduce pollutants in stormwater, increase awareness about stormwater issues, and change negative behaviors;

3) Recommendations for future effectiveness studies; and

4) Descriptions of other groups working to change public behavior to reduce the impacts of stormwater in Puget Sound.

Model for Behavior Change

In recent years, the ideas of social marketing have changed how public education is implemented (Allred et al., 2011). Social marketing has had a profound impact on social issues in the areas of public health, injury prevention, and the environment (Lee and Kotler, 2008). The guiding principles of social marketing are 1) allocate resources to change a specific behavior, 2) conduct activities aimed at the target audience, 3) test for the response of the audience, and 4) ultimately measure indicators in the environment to test for change (Figure 1). In California, stormwater permits are written using the framework of community based social marketing.

Many nonpoint sources of pollution in stormwater derive from common human behaviors; thus, there exists a huge opportunity to reduce stormwater pollution if a large number of people make even a small change in their behavior. Earlier models of public education were based on the idea that if people knew more about the issues, they would make rational decisions that are good for the environment.

The new idea is to change behavior by identifying the barriers to change and working to remove the barriers. Behavior change campaigns tailored specifically to people that are performing negative behavior are more effective than a scattershot approach to everyone. Research has shifted aware from understanding the problem, toward identifying which behaviors cause the biggest problems, and which people are doing them. Social marketing emphasizes the value of knowing your target audience, that is, what is important to people whose behavior you want to change (Ryan, 2009). This conceptual model is the foundation for many of the documents reviewed here.

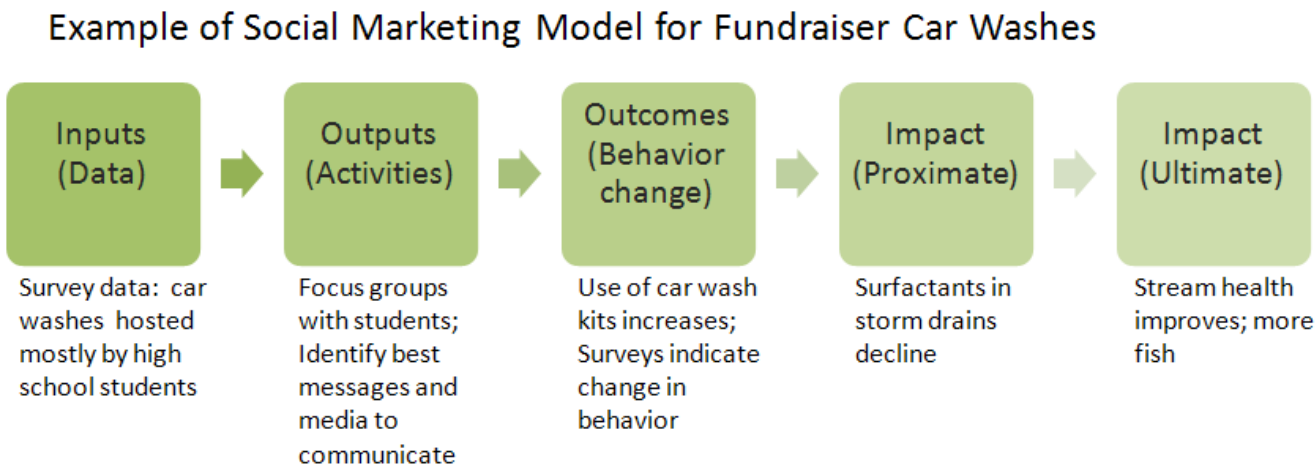

Figure 1. Social marketing model with example activities for fundraiser car washes.

Testing for Effectiveness of Behavior Change

There are multiple points in a (simple) model of behavior change where we can test for the effectiveness of public education and outreach programs (Figure 1). As an example, fundraiser car washes can result in hundreds

of gallons of untreated water going in to storm drains. At the output step, we can evaluate whether planned activities were successful, specifically, did people read or hear the message and understand it. At the outcome step, changes in behavior are typically reported. Surveys are often used and people are asked to about their behavior. One caveat here is that self-reported data can be overly optimistic (Taylor and Wong, 2002). At the other end of the model, detecting a change in stream health can be challenging because of the many influences in a watershed. For this reason, intermediate outcomes are often best because they avoid self reporting bias and provide an objective measure of effectiveness. Intermediate outcomes include counting the number of car washes that use kits to prevent waste water from going down the drain.

Prioritizing Behaviors for Change

For a single identified problem, this approach is straightforward although not necessarily simple. For a multidimensional problem like stormwater, a larger frame may be needed to first select among the various behaviors that affect stormwater. A project in Ontario to reduce phosphorus in agricultural waterways provides an example of a simple, structured approach to prioritize behaviors (Lura Consulting, 2010). For this study, at the input step, a literature review identified all sources of phosphorus related to local farming practices. An expert panel shortened the list according to how widespread the negative activity was and the amount of impact a change in behavior was likely to have. At the output step, focus groups of farmers prioritized the list of behaviors according to potential barriers and benefits. Finally, they created a graphic plot with impact on streams as one axis and probability of behavior change as the other. The highest scoring behaviors were targeted with additional education programs.

The WRIA 8 Salmon Recovery Council used a similar approach to prioritize public behaviors for change programs by first developing a rough ranking of the behaviors most important to salmon recovery and next ranking behaviors according to how easy they are to change (Sage Enviro, 2009a). From this matrix they developed specific behavior change activities for target audiences.

Worth noting here is that the list of possible behaviors developed for WRIA 8 salmon recovery was more inclusive and more tightly connected to the ultimate desired outcome of healthy watersheds than a list of possible behaviors typically derived from stormwater permits. The regulatory framework of the Clean Water Act has historically focused on water quality parameters such as nutrients and bacteria. In contrast, the Endangered Species Act has a greater focus on habitat. Within the context of Chinook recovery, WRIA 8 stakeholders identified key outcomes related to landscape design of shorelines, native plantings, and removal of invasive plants, along with outcomes more typically associated with stormwater management (Sage Enviro, 2009b).

The questions developed by the Stormwater Work Group for this project reflect the historic emphasis on water quality measures even though the Clean Water Act's goals emphasize protection of the "chemical, physical and biological integrity" of rivers and streams. Thus, behaviors related to habitat management might also be considered for public education.

Answering Questions from the Stormwater Work Group

The questions about effectiveness monitoring developed by the Stormwater Work Group represent a successful process to work as a group to make regional decisions about stormwater management based on the best available science and the professional expertise of group members.

This document is organized to align with the questions posed by the Stormwater Work Group. Each of the four general questions is addressed first and followed by responses to the more specific questions in each section. For the more specific questions, I document whether the question has been answered already, whether it is the

right question to ask, and how we might ask a better question. Under each question I review related journal articles and local, unpublished reports prepared by regional consultants and stormwater professionals that address the topic of the question.

3. Does public education decrease pollutants in stormwater?

This is a great question that has not been well answered. Two studies documented a reduction in nutrients as a result of lawn owners changing their behavior (see question 3.b. below). Another study showed that bacteria declined significantly in a Kitsap County stream as a result of an education campaign (see question 9.b. below). In WRIA 8, stakeholders are designing studies to connect human behavior with changes in stream condition at a watershed scale, but results are not yet available.

In general, the effectiveness of public education campaigns is typically measured in terms of behavior change rather than the ultimate impact of the project on stream health. In the language of social marketing, measures of effectiveness are typically done for *outputs* rather than *outcome* (see Figure 1). When testing for the effectiveness of an education program, change in behavior is typically measured. Measures are usually based on surveys where people self-report their behavior. Taylor and Wong (2002) caution that self-reporting can be overly optimistic and that direct measures of behavior are more reliable.

It is both difficult to measure and to compare the relative effectiveness of nonstructural best management practices (BMPs) such as public education, city planning, and regulatory ordinances. Taylor et al. (2007) note that there is very little published guidance for measuring the effectiveness of nonstructural BMPs.

A recent assessment of stormwater needs for Puget Sound municipalities found there was not enough information available to evaluate the effectiveness of public education programs at the level of the stream (Bissonnette and Parametrix, 2010). Measuring the effectiveness of public education is an emerging field of research with great opportunities to make an impact.

a. Are fecal coliform levels in stormwater reduced after pet waste education?

This is a good question about outcomes and I found no studies that tested for a decline in fecal bacteria as a result of pet waste education.

Regional surveys of behaviors indicate that dog owners dispose of waste properly most of the time. A survey of 2000 Puget Sound residents found that 87% of dog owners usually or always pick up dog waste and 45% usually or always put it in the trash (PSP, 2012b). A similar survey in King County found an increase in proper dog waste disposal from 52% in 2008 to 74% in 2011 (Tarnai, 2011). From a survey of Kitsap County residents, about half of dog owners pick up waste every time while walking (54%) and others pick up most of the time (19%). Answers to these questions did not change from 2008 to 2011 (CEC, 2011a). A seven-city survey in Puget Sound found that 90% of dog owners reported they always pick up dog waste (Klima and Buttenob, 2009). Results from these surveys indicate that residents of more urban areas were more likely to dispose of dog waste properly than residents of rural or suburbanizing areas.

b. Are nutrient levels in stormwater reduced after natural yard care education?

Two studies compared nutrient levels in stormwater drains after phosphorus fertilizers were restricted. In a before/after study design, Lehman et al. (2009) documented the effects of public education programs and a city ordinance banning lawn fertilizer in Ann Arbor, MI near the Huron River. Within one year of the ban, they documented a 28% decrease in phosphorus loading measured at stormwater drains. Results were based on weekly samples from May to September. A similar study in Minnesota used paired watersheds to test whether restricting the use of fertilizers containing phosphorus reduced phosphorus in stormwater (Vlach et al., 2010). For watersheds with fertilizer restrictions, the study documented a significant reduction (25%) of phosphorus as

measured by stormwater concentrations in the catch basin. Data comparison was complicated because concentrations had to be adjusted for flow, impervious cover and watershed size.

A related study in Ontario looked at phosphorus reduction in an agricultural setting (Lura Consulting, 2010). This study is a very good example of community-based social marketing techniques and includes an excellent example of how to prioritize behaviors for change. Scientific experts identified sources of phosphorus and their relative impact. Farmers with the most potential for reducing phosphorus use (the target audience) were identified and they developed a list of possible behaviors to reduce phosphorus. The list of behaviors was ranked according to the potential impact on phosphorus reduction and the probability of the preferred behavior being adopted. Unfortunately, the effectiveness of the program, which included education, workshops and individual contact, has not been reported.

Here in Puget Sound, a survey of 2000 residents found that 51% report that they never or seldom use fertilizer (PSP, 2012b). In Kitsap County, self-reported chemical fertilizer use declined dramatically from 52% in 2008 to 21% in 2011; use of Weed and Feed also declined from 54% to 40% (CEC, 2011a). In King County, a similar survey found an even more dramatic decline in reported use of chemical lawn fertilizer with 84% of respondents saying they never use chemical lawn fertilizer compared to 11% in 2005 (Tarnai, 2011). Changes in behavior indicate that education and social marketing programs were effective in King and Kitsap Counties.

c. Are pesticide concentrations and number of hits reduced in an urban stream after general awareness?

This is a good question about outcomes. I found no studies that directly tested the link between changes in pesticide concentrations and public education. However, a recent report tested for changes in pesticide concentrations in urban and agricultural watersheds and found significant decreasing trends for some pesticides in Thornton Creek, an urban creek in King County. Although the study did not relate observed changes in pesticide use to public education efforts, outreach and behavior change programs are ongoing in Seattle.

A regional survey of 2000 Puget Sound residents found that a majority of yard or garden owners seldom or never use pesticides (78%) or weed killer (65%; PSP, 2012b). A survey of Kitsap County residents found a dramatic decline in pesticide use from 74% in 2008 to 16% in 2011; clearly, whatever methods are being used in Kitsap County are effective (CEC, 2011a). A seven-city survey of 700 residents found that nearly all (97%) respondents reported that they applied insecticide and weed killer at the recommended rates, but did not ask how often they were applied or how many used them (Klima and Buttenob, 2009).

On a related note, Washington State Department of Agriculture planned to mail surveys about pesticide use to 15,000 Puget Sound residents in February 2013 to evaluate how they are used.

d. Does establishing a spill hotline result in reduced stormwater pollutants?

This is a good question about outcomes; I found no studies that related a spill hotline to concentrations of stormwater pollutants.

A 2009 survey of residents in seven cities of Puget Sound found that 34% did not know who to call to report illicit discharges (Klima and Buttenob, 2009). To determine what type of information is needed, Kitsap County funded a study to interview focus groups (N = 21 people) about their use of a Stormwater Hotline (CEC and GRG, 2008). They showed them examples of educational materials and asked them to rate what types of information would be most effective. When asked what would make them change their behavior of not reporting spills, they said the most compelling messages were related to children safety or public health.

Kitsap County established the Water Pollution Hotline and received 118 calls from citizens and municipal staff in 2009-2010. Of these calls, 79% (93) were confirmed to be an illicit discharge (Fohn et al., 2011). A

more recent survey of Kitsap County residents found that although most would report a spill (76%), many do not know the correct number to call (CEC, 2011a). Other respondents didn't know what to do or would probably do nothing.

e. Does fundraiser car washing education reduce surfactants in stormwater?

This is a good question about outcomes. Behavior and attitudes about car washing have changed in recent years, but I found no studies that evaluated whether surfactants have been reduced.

The preferred behavior is to use a commercial car wash that treats the wastewater; second best is to wash on the grass or use a car wash kit to capture the run-off. A survey of Puget Sound residents found that 77% of respondents know that washing cars on the street is harmful; and 60% report that they seldom or never wash cars on the street (PSP, 2012a,b). A similar survey in King County found a steady increase in appropriate car washing from 54% to 62% from 2005 to 2011 (Tarnai, 2011). Although the number of people who washed cars at home in Kitsap County increased (from 58% to 75%), the good news is that the number who let waste water run to the street or a storm drain decreased by 21% (from 47% to 26%; CEC, 2011a).

Fundraiser car washes continue to be popular. A recent phone survey of ~800 residents of Kitsap County found that 55% of respondents use them and that number did not change from 2008 to 2011. Nonetheless, there was a big change in attitude: an increase of 22% of respondents thought car washes should be restricted to places where the stormwater and run-off is treated (42% to 64%; CEC, 2011a).

Issaquah, Bellevue, Woodinville, Reston, and Redmond lend car wash kits to charity events and businesses (Sage Enviro, 2009b). Bellevue found too much human error associated with the kits and Redmond is currently evaluating their program. One problem with fundraiser car washes is that 67% of people surveyed believe that biodegradable soap is safe to use for washing cars on the street, it's not (seven-city survey, Klima and Buttenob, 2009)

9. Does public education increase awareness and change behavior?

The answer is yes. The peer-reviewed literature broadly supports the idea that public education is effective (Taylor and Wong, 2002). As an example, in Puget Sound a recent survey found that 96% of 2000 respondents reported that they never flush chemicals such as paint thinner down the drain; and 94% never flush prescription drugs (PSP, 2012b). Past education campaigns for these issues, such as *Puget Sound Starts Here*, were obviously effective.

Residents of Puget Sound are also highly aware of stormwater problems and how they threaten the health of Puget Sound. A survey of 2000 residents in Puget Sound found that 61% believe that clean up is urgent (PSP, 2012a). A majority of respondents know that lawn chemicals (89%), car washing on the street (77%), weed and feed (77%), and leaving dog waste (63%) are all harmful to Puget Sound (PSP, 2012a). Demonstrating a similar knowledge of local issues, a focus group in a Kitsap County study was able to name all the behaviors associated with stormwater runoff problems (CEC and GRG, 2008).

Two recent studies document a change in Puget Sound residents' attitudes and behaviors. When residents of Kitsap County were surveyed in 2011, they showed a 33% increase in awareness of ways that people can prevent water pollution since 2008 (40% to 73%; CEC, 2011a). Clearly education campaigns are increasing awareness.

Experts emphasize that awareness is not equal to behavior change; nor is a change in awareness a good predictor of a change in behavior (PSP, 2012a; Taylor and Wong, 2002). For example, in Pierce County no relationship was found between awareness of the correct behavior and the actual behavior related to lawn chemicals and lawn care (Elway, 2009). The reverse is also true, people may do the right behavior without

knowing why it's the right thing to do. For example, small business owners can reliably be taught not to put pollutants down the storm drain without knowing that stormwater is untreated (CEC, 2011b).

For these reasons, public surveys have shifted to questions about specific behaviors rather than attitudes. A comparison of responses by ~800 Kitsap County residents from 2008 to 2011 found that self-reported chemical fertilizer use declined dramatically (31%); pesticide use declined dramatically (47%); and organic fertilizer use increased (12%; CEC, 2011a). Car washing behavior also changed with more respondents washing cars away from storm drains and streets. In King County a similar survey of ~2000 residents showed a dramatic decline in the reported use of chemical lawn fertilizer (73%) from 2005 to 2011; and a 22% increase in dog owners who always pick up waste (Tarnai, 2011).

Puget Sound Partnership's recent regional survey identified a group of respondents described as "ready and willing." They represented 50% of respondents and agree that Puget Sound is in poor condition and it's going to get worse. They believe clean up is extremely urgent and they know what's harmful to water quality and want to do all they can to protect the environment (PSP, 2012a). Furthermore, 83% of respondents agreed with the statement that one person's actions can make a difference. These are the people who could be asked to do more.

a. What is the change over time of various target audiences willing to make a simple change in their daily lives to help Puget Sound?

This question is very general; a better question would focus on specific behaviors and whether there has been a change in the behavior, rather than the willingness to change.

A survey of Pierce County 700 residents found that 43% of respondents were willing to change their behavior to prevent water pollution even if it involves sacrifices; another 40% were willing to make changes if they are easy (Elway, 2009). In Snohomish County, a survey of 400 residents found that 78% were willing to do more to reduce their impact on rivers and streams (33% very and 43% somewhat willing); however, many were not sure what to do (Grove Quirk Insight, 2002). Focus groups were not effective in that learning about problems did not change participants' willingness to do more.

b. What is the change over time of various target audiences willing to invest over $1,000 to make a change in their property to help Puget Sound?

This question is very general and not focused on a specific behavior change. I found no surveys of the change in residents' willingness to pay a specific amount to change their property. Related surveys suggest that respondents are willing to pay more money to protect Puget Sound. A survey of Puget Sound residents in 2008 found that 46% of respondents were willing to pay more to clean up Puget Sound (Elway, 2008). In Pierce County, a survey of 700 residents found that most respondents (60%) support additional fees for surface water management projects (39% somewhat supportive and 21% strongly supportive; Elway Research, 2009).

A survey of small business owners found they were not interested in applying for grants or being provided with government help to make structural changes (CEC, 2011b). Many small contractors don't want to be involved with government programs and prefer to keep a low profile. In contrast, small farmers in Kitsap County pursued grants and funding to clean up animal waste and the result was a measureable reduction of fecal bacteria in Dogfish Creek (Puget Sound Action Team, 2005).

c. What is the change over time of car owners to fix leaks?

This is a good question because it focuses on specific behavior that can be measured. I found no studies that compared the change in this behavior over time. In a survey of 1800 residents of King County, the majority reported in 2011 that they always fix car leaks (67%) and others sometimes fix car leaks (10%; Tarnai, 2011). A

similar survey of 900 people living in seven cities in Puget Sound found that 90% of respondents reported that they fix car leaks within three weeks (Klima and Buttenob, 2009). Stormwater Outreach for Regional Municipalities (STORM), City of Seattle, King County ECO Net, and the Puget Sound Partnership are actively working on this issue.

d. What is the change in stormwater drain awareness of various business sectors involved in commercial property maintenance inspections?

This question asks about awareness rather than behavior change. A better question would be: What types of educational materials are successful in promoting the desired changes in behaviors?

A summary of programs targeting businesses was reviewed by CEC (2011b) for Kitsap County. The study addressed social marketing strategies for grocery stores, mobile painters and cleaners, automotive businesses, and restaurants. Several studies asked participants about which types of education are most effective. Simple graphic posters and photographs of the preferred behaviors were rated most highly. Interviews and focus groups support the idea that these methods are more effective in changing behavior because many small businesses are hard to reach with mailed or written materials, workshops, or offers of grants to make changes (CEC, 2011b). The review did not clarify which businesses are involved in property maintenance inspections.

e. Does a fundraiser car wash education program decrease the number of fundraiser car wash events?

Behavior and attitudes about car washing have changed in recent years, but it's not clear if the actual number of car washes has declined. See more detail about car wash behavior above under question 3.e.

16. Does public education of lake property owners reduce summer algae blooms?

a. Are summer algae blooms due to excess runoff or recycling of nutrients?

This question is somewhat outside the scope of this review; however, a recent review by Schindler (2012) summarizes the evidence for causes of eutrophication and concluded that the only proven way to reduce algal blooms is to reduce the input of phosphorus. The Department of Ecology agrees that for Western Washington lakes, phosphorus is generally implicated more than nitrogen in algal lake blooms. The good news is that it may not be necessary to reduce nitrogen as well, which can be more difficult to eliminate than phosphorus. On the legislative side, in 2011 Washington State passed the "Clean Fertilizers, Healthier Lakes and Rivers" legislation (ESHB 1489) into law. The legislation manages the sale of phosphorus in fertilizers.

b. Can education and prevention of phosphorus loads from runoff influence the frequency and duration of lake algae blooms?

This question goes right to the ultimate desired outcome, reducing lake algal blooms. I found no studies that directly measured the impact of education on algal blooms. On related topics, other studies evaluated the impact of education programs to reduce phosphorus in urban areas and farms. See detail on phosphorus reduction under Question #3.b. above.

17. Does storm drain stenciling increase awareness about untreated stormwater?

a. What is the level of awareness of adjacent land owners to storm drain stencils compared to landowners with no storm drain stencils?

This is a very general question, and assumes that an increase in awareness will cause a change in behavior. One study found that some people assumed all unmarked drains meant the stormwater was treated. Fortunately,

most people (>75%) in Puget Sound know that that they should not use lawn chemicals or wash cars on the street (PSP, 2012a), even if they don't know precisely why. A seven-city survey found that only 44% knew that most stormwater is untreated (Klima and Buttenob, 2009).

A better question about the effectiveness of monitoring would be more specific and measure closer to the outcome. For example, Do people living near stencils put fewer chemicals in the drains? Or, Are fewer chemicals found in stenciled drains? Or, ultimately, Are nearby water bodies healthier? The reality is that testing for these types of affects are expensive while funding a volunteer drain stencil effort is relatively cheap and creates other benefits such as community engagement (Taylor and Wong, 2003).

Regional Connections – Groups Working on Behavior Change

Stormwater Outreach for Regional Municipalities (STORM) is a coalition of city and county governments that is working with Puget Sound Partnership to design and manage behavior change programs. Membership includes more than 50 municipalities, both Phase 1 and Phase 2 permit holders. Their mission is to improve surface water quality by reducing non-point source pollution. STORM fulfills this mission by advancing public behavior change through the promotion of targeted, measurable actions. STORM is working to create a "menu" of options for specific pollutants and behaviors so that new programs can take advantage of lessons learned from programs that are working.

The Puget Sound Partnership has developed a Sound Behavior Index and a Social Capital Index to measure change in behavior and attitudes every two years. The Sound Behavior Index measures 29 behaviors related to yard care, vehicles, home maintenance, pet waste, septics, livestock and boats. The Social Capital Index includes 35 measures related to trust in people and groups, trust in government, public affairs, participation, social media, and feelings about self.

The Puget Sound Partnership formed ECO Net (Education, Communication and Outreach Network) which is a Sound-wide network devoted to building and strengthening relationships among organizations committed to enhancing public awareness, involvement and environmental education. ECO Net's membership is comprised of teachers, program coordinators, public outreach specialists, and volunteers. These groups work on a variety of behavior change projects, many are related to stormwater.

The Stewardship Program at Puget Sound Partnership is compiling literature regarding the scientific basis, usage and public perceptions of Weed and Feed. They will launch a behavior change initiative related to lawn care and pesticide practices this year.

The Department of Ecology uses Chemical Action Plans (CAPs) as the vehicle to reduce threats caused by toxic chemicals and metals. Current CAPs rely partially on behavior change programs to be successful, e.g., addressing lead paint, reducing engine idling and woodstoves, fixing automobile drips, reducing mercury use, and reducing backyard burning.

In their Three-Year Work Plan, the WRIA 8 Salmon Recovery Council identified 10 priority activities to support outreach and education programs and incentive-based support for land use and habitat protection regulations representing a $15 million funding need.

The Modeling Work Group of the Puget Sound Ecosystem Monitoring Program (PSEMP) includes members that have extensive experience with regional models. They could be a resource for understanding the relative importance of nutrients and toxics in stormwater.

Recommendations

1. Recognize the importance of public education and the potential impact at a regional scale of a small behavior change made by a large number of people. Recognize that a large percentage of people are "ready and willing" to do more.
2. Define the desired behavior change, determine who needs to change, identify benefits and barriers to change, remove barriers and test for changes in behavior. Work with experts to create a targeted communication campaign (Clark, 2012).
3. Identify objective, intermediate measures that can be used to measure the effectiveness of public education and behavior change programs. An example of an intermediate measure for proper disposal of dog waste could be counting the number of free dog waste bags used in public places
4. Partner or coordinate with STORM and other existing public education programs to 1) measure the effectiveness of ongoing programs or 2) design new projects that complement (and do not duplicate) existing education and outreach efforts.
5. Build on the framework of the Sound Behavior Index; specifically, assess changes in attitudes and behavior using measures of the index, target specific audiences using existing data, and frame effectiveness monitoring questions to support ongoing, regional education campaigns.

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Note: Many of the unpublished results of surveys, focus groups, and local research can be found on the Puget Sound Partnership's web site: http://www.mypugetsound.net/index.php?option=com_mtree&task=listcats&cat_id=104&Itemid=326. Special thanks to Emily Sanford and Dave Ward (Puget Sound Partnership) for gathering many of these materials from diverse sources and posting them. The web site is being updated and the easiest way to find these titles is to search with Google.

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Appendix 1. Effectiveness Study Topics and Questions from the Stormwater Work Group

Stormwater management topics related to public education and outreach and their relative rank of importance compared to all the proposed effectiveness study topics. Out of a total of 22 ranked topics, 4 were related to public education and outreach. Shown also are questions related to each topic.

Rank	Effectiveness Study Topic Null Hypothesis (H_o)	Potential Questions that could be addressed by an RFP
3	Permit-required public education programs do not result in decreased levels of pollutants in stormwater.	• Are fecal coliform levels in stormwater reduced after an extensive pet waste education program? • Are nutrient levels in stormwater reduced following an extensive natural yard care education program? • Are pesticide concentrations and number of hits reduced in an urban stream following general awareness? • Does establishing a spill hotline result in reduced stormwater pollutants? • Does a fundraiser car washing education program result in reduced surfactants in stormwater?
9	Permit-required public education programs promoting behavior change do not result in increased awareness and behavior change.	• What is the increase or decrease over time of various target audiences willing to make a simple change in their daily lives to help Puget Sound? • What is the increase or decrease over time of various target audiences willing to invest over $1,000 to make a change in their property to help Puget Sound? • What is the increase or decrease over time of car owners to fix leaks? • What is the increase or decrease in stormwater drain awareness of various business sectors involved in commercial property maintenance inspections? • Does a fundraiser car wash education program decrease the number of fundraiser car wash events?
16	Public education of lake property owners about residential pollutants will not reduce summer algae blooms.	• Are summer algae blooms due to excess runoff or recycling of nutrients? • Can education and prevention of phosphorus loads from runoff influence the frequency and duration of lake algae blooms?
17	Storm drain stenciling does not raise awareness about where stormwater goes or that it is not treated.	• What is the level of awareness of adjacent land owners to storm drain stencils compared to landowners with no storm drain stencils?