



DRAIN RANGERS

Stormwater Youth Education Grant- Final Report



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Department of Ecology

Janet Geer

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Sponsors



Partners



Curriculum writers

Patricia Otto- *Pacific Education Institute* Nancy Skerritt- *Pacific Education Institute*

Contributors

Betsy Adams – <i>City of Kirkland</i>	Alan Harvey – <i>Woodmont K-8 School</i>
Justine Asohmbom – <i>WA Dept. of Ecology</i>	Jennifer Howell – <i>Triangle Associates</i>
Ginny Ballard – <i>Nature Vision</i>	Apryl Hynes – <i>City of Everett</i>
Darcy Borg – <i>Camelot Elementary School</i>	Lena Jones – <i>Issaquah School District</i>
Emily Hegarty – <i>City of Bellevue</i>	Pat Kirschbaum – <i>Kitsap County</i>
Laurie Devereaux – <i>Bellevue Stream Team</i>	Bill Malatinsky – <i>City of Seattle</i>
Peter Donaldson – <i>Sustainability Ambassadors</i>	Adrienne McKay – <i>Totem Middle School</i>
Kristin Edlund – <i>Pacific Education Institute</i>	Kristin Covey – <i>King County</i>
Dani Fischer – <i>Camelot Elementary School</i>	Ryan Patterson – <i>Wildwood Elementary School</i>
Brad Street – <i>Islandwood</i>	Mary Rabourn – <i>King County</i>
Mary Eidman – <i>City of Burien</i>	Hollie Shilley – <i>City of Federal Way</i>
Janet Geer – <i>City of Bothell</i>	Robert Sotak – <i>Pacific Education Institute</i>
Mike Halliday – <i>Pierce County</i>	Celina Steiger – <i>Islandwood</i>
Scott Hanis – <i>City of Black Diamond</i>	Megan Walker – <i>Federal Way School District</i>
Brad Street – <i>Islandwood</i>	Dawn Wallace – <i>Issaquah School District</i>
Kate Bedient- <i>Islandwood</i>	Susan Tallarico – <i>King County</i>

Evaluator

Applied Research Northwest

Executive Summary

Polluted stormwater runoff is the single largest source of pollution entering Puget Sound. In Washington State, stormwater education curriculum is administered sporadically in some schools and not at all in others. As a result, students do not obtain a basic understanding of what stormwater is, its impacts, or the behaviors that contribute to polluted stormwater runoff.

In 2013, Stormwater Outreach for Regional Municipalities (STORM) and the Puget Sound Partnership (PSP) worked together with the Pacific Education Institute (PEI), as well as teachers, informal educators, and curriculum administrators around the region to develop a curriculum for both elementary and secondary students that met everyone's needs. This curriculum introduces students to a problem solving model where they think like an engineer and explore ways to solve the problem of polluted stormwater runoff. The lessons and units are specifically designed to meet classroom requirements of the Common Core and Next Generation Science Standards while teaching students the skills to solve stormwater issues in their community.

The goals of this grant were to assist formal and informal educators with implementing the curriculum, create additional tools and resources for teachers to use, adapt the curriculum for Eastern WA jurisdictions, and develop evaluation questions and strategies that can be used to gauge student learning.

The partners on this grant effort were able to meet and exceed our expectations for our task deliverables. Accomplishments included:

- Conducted 15 teachers trainings for 183 formal and informal educators
- Piloted various existing and new portions of the curriculum in 9 schools
- Revised and improved both of the curriculum for Western WA teachers
- Adapted the curriculum for Eastern WA elementary students
- Developed four videos, six illustrations, 13 fact sheets, and five posters to assist teachers with implementation
- Evaluated 70 teachers and 203 students to measure teacher understanding and student learning.
- Currently 34 schools are signed up to implement the curriculum in 2017-18 and 70 schools in 2018-19.

Introduction

The National Pollutant Discharge Elimination System (NPDES) permit was issued to all Western Washington jurisdictions in 2007 with education and outreach requirements that had to be initiated by 2009. Many jurisdictions realized that the permit target audiences called out in the education and outreach section of the permit may live in one jurisdiction, while working and playing in other jurisdictions so it wasn't as effective to create programs in a local vacuum. A regional coalition was formed to develop regional awareness communication strategies, while

strengthening outreach messaging and resources that support local, on-the ground behavior change programs.

King County received a grant from the Department of Ecology (Ecology) in 2009 on behalf of STORM to develop a regional awareness campaign and website called *Puget Sound Starts Here*. This grant included a small amount of funding to develop youth education materials, the basis for Drain Rangers. These original materials contained information on why polluted stormwater runoff was a problem and what kids could do at home to help. It included a pledge to help protect Puget Sound and a badge for kids to become deputized as a “Drain Ranger.”

Snohomish County received another grant from Ecology in 2010 on behalf of STORM to further the Puget Sound Starts Here campaign which again included a small amount of funding to enhance Drain Rangers. A new logo and style guide was created and goals for developing Drain Ranger branded supporting materials and resources for existing youth stormwater education efforts were identified.

In 2013, school age youth were added to the NPDES permit as a target audience. This caused jurisdictional staff to look critically at stormwater related education in their jurisdictions. They found that many teachers didn’t have a good understanding of basic stormwater concepts and that providing supplemental materials wasn’t enough. Teachers needed relevant curriculum as well as training to feel confident in administering the curriculum.

The nature of schools and school districts as independent entities does not allow you to develop a lesson, deliver it to each district, and expect distribution throughout the district. We needed to work directly with educators and administrators to find out what curriculum was already being used and what was needed-and work with them to develop the Drain Rangers curriculum to meet their needs. Additionally, training was needed to ensure that educators were comfortable administering the lessons, and to eliminate barriers associated with cost, materials and resources needed to be provided to the teachers for free.

STORM and PSP worked together with PEI, teachers, informal educators, and curriculum administrators to develop a stormwater curriculum for both elementary and secondary students. This curriculum introduced students to a problem solving model where they think like an engineer and explore ways to solve the problem of polluted stormwater runoff. The lessons and units were specifically designed to meet classroom requirements of the Common Core and Next Generation Science Standards.

PEI created the “what’s in it for me” for teachers by developing stormwater-themed practice tests that simulated the format of tests that public schools are required to take. Teachers can give these tests to their students as a way to practice and apply the new learning standards using a real world issue.

In 2015, STORM received a grant from Ecology to do the following: refine the curriculum based on initial feedback; pilot the curriculum in more classrooms; develop supporting materials to

encourage implementation; and evaluate student knowledge of what stormwater is, why it's a problem, and how they can help. Budget constraints forced Ecology to withhold funding until June 2016, reducing our timeline by eight months and causing partners to lose a whole school year cycle. The following work completed was truly a testament to the strength of the partners- the Pacific Education Institute (PEI), King County, and Islandwood- because they were able to complete much of the work and deliverables listed in the grant with a reduced timeline. However, the evaluation suffered because testing methods couldn't be fielded in the classroom prior to implementation.

Implementation

Our grant was broken into various tasks with deliverables which were assigned to partners based on their mission, scope, and expertise. The tasks included; curriculum, in classroom piloting and support, teacher training, resource materials, and evaluation.

Curriculum

Each district, school, and individual classroom has specific needs based on their existing curriculum and various constraints. This means the curriculum needed to be tailored to each classroom. Partners worked with teachers across the State to teach them the curriculum and to help them adapt the tools and resources to meet their specific needs. To ensure the key stormwater concepts were being taught within each adaptation, PEI reviewed the curriculum and resource material adaptations made by King County and Islandwood. PEI also edited the existing curriculum and resources pages based on teacher feedback.

The Seattle Public Schools (SPS) wanted to adapt their existing Land and Water unit to incorporate the stormwater concepts rather than adopting a whole new curriculum, so Islandwood revised their existing Land and Water unit. They then piloted the unit with SPS and made adjustments based on teacher feedback. As a result of these efforts, this revised unit will be taught to every 4th grade student within SPS.

The Northshore School District (Northshore) wanted to adapt the lessons within their existing FOSS water kit, so Islandwood again incorporated the Drain Ranger concepts into their existing curriculum and piloted the lessons. This adaptation effort included research into current and future science unit needs. Due to grant time constraints, another grant effort will fund revisions to the curriculum based on our piloting.

Field curriculum was created by all partners to help students explore and investigate their existing stormwater infrastructure, issues, and site conditions. Low Impact Development (LID) principles and Green Stormwater Infrastructure (GSI) practices were incorporated into the field curriculum so students could also explore potential solutions to the issues they found during their investigations.

In classroom support and piloting

Relationships were established with curriculum administrators, elementary school teachers, and science departments to support stormwater learning in the classroom. Nine schools participated in piloting existing or new portions of the curriculum. The schools were:

- John Rogers Elementary (SPS)- 2 teachers
- Broadview Thomson (SPS)- 2 teachers (4 classes)
- Hazel Wolf K-8 (SPS)- 3 teachers
- Concord International Elementary (SPS)- 2 teachers
- Crystal Springs Elementary (NSD)- 6 teachers
- Chief Sealth International High School- 2 classes
- Puget Sound Community School- 1 class
- Roosevelt High School- 1 class
- Seattle Academy of Arts and Sciences- 1 teacher (five classes)

Feedback from these teachers was actively sought and used to improve the curriculum. Based on the feedback, we expanded and/or shortened portions as needed, provided "walking field trip" opportunities, and shaped the videos and resources to maximize usefulness.

Teacher training

15 professional learning opportunities for 98 formal and 85 informal educators took place around the State- in Seattle, Bothell, Bremerton, Woodinville, Puyallup, Marysville, Vancouver, Ellensburg, and Spokane. Participation was limited due to the fact that the grant did not allow for teacher stipends to pay for substitute teachers or travel expenses.

Support Materials

Videos

PEI, Islandwood, King County, and Bothell worked with the videographer, Transect Films, to create a video series using stop motion animation. The first two videos introduced basic stormwater concepts, definitions, and engineering. The third video was developed for the elementary curriculum to introduce the engineering design process and provide a real world example. The fourth video was developed for the secondary curriculum and describes a more in-depth engineering design process they use to discover and improve stormwater solutions.

Illustrations

Illustrations were created to help show key concepts and assist with visual learning. These illustrations were adapted into posters and overhead projections for the classroom.

Solution Pages

Best Management Practice (BMP) pages were created to help students learn about potential stormwater solutions. They could then compare the BMP's and choose the best option based on their site conditions and constraints. A comparison sheet was created for all of the LID/GSI practices to further assist students with visualizing and comparing the constraints.

Modeling

Lessons were created by King County to help secondary students further their learning without needing to leave the classroom. LID/GSI models, career cards, water quality testing, stream health evaluations, and pervious surface calculations were created based on the needs of each grade level, class subject, and timeline.

Evaluation

The existing evaluators on staff were unable to complete evaluation for all of the curriculum, so an external evaluator was hired to create student assessments and teacher surveys to receive feedback on the training methods, curriculum, and understanding of the stormwater concepts.

Because of the shortened grant timeline, we were unable to create a pictorial student assessment and test it in the classroom. Instead, we had to use student survey questions which weren't ideal for the teachers. Additionally, grant timing made evaluation challenging due to spring teachers not finishing in time for the evaluator to incorporate their pre and post tests and teacher feedback. Teacher interviews were incorporated to gather some of this missing data, but it wasn't as strong as the complete assessments.

Teacher Findings

After receiving training, teachers reported strong gains in understanding stormwater runoff problems with moderate gains in understanding the engineering design process and stormwater solutions. The top barriers identified by classroom teachers during curriculum implementation were time to adjust their lesson plans and access to materials and supplies. For most teachers, additional time and site visit assistance from a trainer were listed as desirable methods of support. Several teachers provided comment on their learning experience which were overall positive in nature. Here are some examples:

"I used to think that stormwater runoff was more controlled by city officials than it currently is, but now I know we have many things we can do as citizens, homeowners, and businesses to improve stormwater quality."

"I used to think that stormwater runoff might be inaccessible for my grade 5, but now I know this is doable and so very relevant"

"I used to think there was not a lot we could do besides awareness, but now I know with support our school could take significant action to improve the water quality of [a local creek]."

“I used to think that stormwater runoff was an industrial problem, but now I know that we contribute to it”

Student Learning

The goal of evaluating student learning was to ensure all curriculum adaptations provided adequate understanding of what stormwater is, why it’s a problem, and what they can do to solve it. We did not have adequate time to develop and test pictorial assessments so survey questions were developed to assess the following:

- Defining stormwater runoff
- Identifying pervious and impervious surfaces
- Describing three problems that can be caused by stormwater runoff
- Describing three possible solutions for stormwater runoff problems
- Identifying steps in the engineering design process from a list of many approaches an engineer might take to develop a solution to stormwater runoff problems

203 pre and post tests were provided for evaluation, but only 42 of them were able to be matched due to student names being redacted. The matched pre and post tests showed statistically significant gains in understanding which were similar to the unmatched test scores. Both showed an increase of 4 out of 19 points or 21% increase in correct answers. Open ended items were scored by two independent evaluators and reviewed for consistency. Understanding pervious vs. impervious, what stormwater is, and why it’s a problem were where we saw the greatest gains. Defining engineering practices and identifying solutions tended to show weaker gains.

Recommendations

Raising awareness about stormwater impacts and solutions allows students and parents to change behaviors that cause or contribute to stormwater pollution. Studies have shown that kids are a high motivator for parents to change or adopt new behaviors, so they are an effective target audience for stormwater awareness. They are also the next generation that will be facing these issues so any knowledge and problem solving skills we can provide will help all of us in the future. The following recommendations from the grant partners and evaluation are provided to assist with continued efforts to expand and improve the curriculum.

- The curriculum should be updated as new information, solutions, and resources are made available. Teachers and students alike found a lot of value in the LID/GSI models for understanding how these concepts work. Additional lessons for constructing and testing LID/GSI models should developed and improved.
- Partners should work with cities, counties, libraries, and universities in Washington to offer easy access for local historical information about specific neighborhoods. This information helps students understand water management over time and its impacts on the community.

- As cities and counties make online mapping tools available to the public they should include storm drains, pipes, LID/GSI projects, and surface water features (streams, creeks, watershed boundaries, etc.) for greater public understanding of stormwater and for use in the classroom.
- Organizing a career panel, or creating a lesson about a variety of careers in the field of stormwater would be very beneficial for secondary students. Not all students resonated with a career in engineering and learning about biologists, communications staff, and field technicians helped them better understand the complexity of stormwater concepts.
- The workshop model for training teachers should be used whenever possible with classroom follow-up or assistance as requested.
- A pictorial student assessment should be developed so that teachers can use either assessment method.