



**Learning Urban Watersheds
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**Final Report
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Submitted to:

**Environmental Education Grants Program
U.S. Environmental Protection Agency
Region 6**

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Introduction

The Learning Urban Watersheds project was funded through a \$15,412 U.S. EPA Environmental Education Grant that was awarded September 20, 2005. An additional \$19,642 in collaborative funds was contributed through local and state partnerships. The project combined Texas Watch, Texas Nature Trackers, and Project WILD in a coordinated effort to increase environmental literacy among high school and middle school students through teacher training and interdisciplinary curriculum. The goal of the project was to design new programs that, by increasing environmental literacy capacities among teachers and students, support strategies to protect and improve water quality.

This report covers activities between September 20, 2005, and September 15, 2007, and is structured as follows:

- Section 1: Science Standards Applied
- Section 2: Activities Performed
- Section 3: Project Innovation
- Section 4: EPA Priorities Addressed
- Section 5: Problems Encountered
- Section 6: Audience Reached and Breadth of Application
- Section 7: Additional Beneficiaries and Future Dissemination
- Section 8: Environmental Outcomes

The leadership staff for Learning Urban Watersheds consisted of the following people: Eric Mendelman, Principal Investigator (Texas Watch, Texas State University–San Marcos); Julie Tuason, Project Coordinator (Texas Watch, Texas State University–San Marcos); Marsha May (Texas Nature Trackers, Texas Parks and Wildlife Department); Cappy Manly (Project WILD, Texas Parks and Wildlife Department); and Cheryl Boyette, independent evaluator.

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Section 1: Science Standards Applied

The Learning Urban Watersheds project applied pre-existing training procedures and curriculum materials that have been developed by Texas Watch, Texas Amphibian Watch, and Project WILD Aquatic. Scientific standards are maintained in different ways by each program.

1.1: Texas Watch – Volunteer Water Quality Monitoring

Texas Watch maintains a Quality Assurance Project Plan (QAPP) on file with the U.S. Environmental Protection Agency and the Texas Commission on Environmental Quality (TCEQ). The purpose of the QAPP is to clearly delineate the Texas Watch quality assurance policy, management structure, and policies that will be used to implement the quality assurance requirements necessary to document the reliability and validity of environmental data. The QAPP ensures that all data submitted to the Texas Watch database have been collected and analyzed in a way that assures its reliability and therefore can be used for educational purposes, local decision-making, research, screening and problem identification, and other uses deemed appropriate by resource managers and the TCEQ.

1.2: Texas Parks and Wildlife – Texas Nature Trackers (Amphibian Watch)

All data collected by Texas Nature Trackers volunteer monitors is reviewed by Texas Parks and Wildlife Department (TPWD) biologists. Volunteers undergo intensive, science-based training to become a monitor. Volunteers receive backup materials that have been developed by TPWD biologists and science educators. All of the activities are aligned with the Texas Essential Knowledge and Skills (TEKS) and are approved by the State Board of Education for continuing education credit in science.

1.3: Texas Parks and Wildlife – Project WILD (Aquatic)

All of the Project WILD activities are also aligned to the TEKS and approved by the State Board of Education for continuing education credit in science for teachers. The curriculum materials were developed by the Western Association of Fish and Wildlife Agencies (WAFWA) in partnership with education and natural resource professionals, and they underwent extensive scientific review prior to publication. WAFWA membership is comprised of the directors of public agencies responsible for management of wildlife in their respective states.

Section 2: Activities Performed

2.1: “SPLASH into Learning” Field Event

The kick-off event for the Learning Urban Watershed Project was a one-day outdoor event called “Splash Into Learning,” held on October 17, 2005, to coincide with World Water Monitoring Day, a global event held annually in October (Fig. 1). “Splash” took place at the City of Austin’s Beverly S. Sheffield Education Center, located in Zilker Park along the shore of Barton Creek. The event drew nearly 400 students from eight elementary and middle schools in and around Austin (see article, Attachment A). Activities included (among many others) hands-on water quality monitoring demonstrations, an amphibian monitoring presentation, boater safety instruction, and presentations on the watershed concept. This event was organized by the Texas Watch, TPWD, the City of Austin, and the Lower Colorado River Authority.



Figure 1. Austin students at “SPLASH” event.

2.2: Teacher Recruitment

We recruited teachers for the project by distributing a one-page flyer as an email attachment sent to science curriculum coordinators, Texas Watch partners, and TPWD local contacts in the Houston and

Dallas-Fort Worth areas (see flyer, Attachment B). Recruitment began in January 2006 but was interrupted by the departure of Texas Watch's graduate student assistant in early May. Recruitment resumed in June, with an added emphasis on local area nature centers as distribution points for the program recruitment flyer. By early July, we were able to get firm commitments from a total of 13 teachers to attend the summer workshops (see article, Attachment C).

The original intent of the project was to recruit 18 high school science teachers from low performing schools in the Houston and Dallas-Fort Worth metropolitan areas. Due to a low response rate from teachers, the school demographics for the teachers whom we were able to recruit fell partially outside of this original criterion. Schools ran the gamut from high performing to low performing schools, as indicated by mean SAT scores (Table 1).

School	Grade Levels	Population	African American	Hispanic	White	Asian	Mean SAT	Economically Disadvantaged
Austin H.S.	9-12	1,825	3.3%	95.1%	1.1%		805	91.8%
Brazoswood H.S.	9-12	2,624	7.9%	27.2%	62%		1055	22.6%
Diamond Hill-Jarvis H.S.	9-12	886	5%	90.9%	4.1%		838	81%
Hebron H.S.	9-12	2,162	13.7%	9.6%	55.8%	20.6%	1043	11.1%
Kingwood H.S.	9-12	4,108	3.5%	8.5%	84.1%		1116	6.0%
Webb M.S.	6-8	1,180	20%	24.3%	38%	17.3%	n/a	40.3%

Table 1. School profiles (source: Texas Education Agency).

2.3: Teacher Training Workshops

Two teacher training workshops were held during the month of July preceding the 2006-07 school year. Each workshop lasted two days and included intensive training in Texas Watch water quality monitoring, Texas Nature Trackers Amphibian Watch monitoring, and Project WILD Aquatic (see sample agenda, Attachment D). A complete set of supporting curriculum materials for all three programs was given to the teachers, as well as Texas Watch monitoring kits and Amphibian Watch audio CDs for identification of frog and toad species in the field.

The Houston area teacher training workshop was held at Sheldon Lake State Park on July 10-11, 2006 (Fig. 2). Five teachers participated (representing four high schools), as did the Learning Urban Watersheds local coordinator, Gayla Stock, from the Houston-Galveston Area Council. The Dallas area workshop was held on July 24-25 in the conference center at Loyd Park in Grand Prairie (Fig. 3). Eight teachers, representing five high schools and one middle school, attended. Tammy Chan of the City of Grand Prairie also attended, as the Dallas area local coordinator for the project.

In addition to the training received in Texas Watch, Amphibian Watch, and Project WILD Aquatic, we also discussed the project requirements, the evaluation procedure, the concept of environmental literacy and ways in which to cultivate stewardship (see stewardship handout, Attachment E).

We administered pre- and post-workshop surveys to assess participants' content knowledge of the three programs (Texas Watch, Texas Amphibian Watch, and Project WILD Aquatic). The surveys also gathered information on attitudes and opinions regarding water quality issues.



Figure 2. Houston area teacher training workshop.



Figure 3. Dallas-Fort Worth area teacher training workshop

2.4: Classroom Implementation

The 13 participating teachers were charged with the mission of implementing Learning Urban Watersheds monitoring activities and associated curriculum according to whatever schedule they deemed appropriate. The courses in which the project was implemented ranged from middle school Environmental Science to high school Aquatic Science and Advanced Placement Environmental Science (Table 2). Some of these courses were semester-long, and others were year-long in duration. In one case, a teacher had a trimester-based schedule.

Project Area	Teacher	Course	Grade(s)	Term	Enrollment
Dallas-Fort Worth	Louis Dagenais	Chemistry	10	Fall	63
		Chemistry	10	Spring	41
		Geology, Meteorology, and Oceanography	10, 11	Spring	18
	Anna Ferguson	AP Environmental Science	11, 12	1st and 2nd Trimester	14
	Amy George	Environmental Systems	12	Fall	13
		Geology, Meteorology, and Oceanography	12	Fall	13
		Geology, Meteorology, and Oceanography	11, 12	Spring	60
	Bill Ingram	AP Environmental Science	11, 12	All year	20
		Environmental Chemistry	11, 12	All year	75
	Chris Long	Environmental Science	8	Fall	42
		Environmental Science	8	Spring	42
	Natalie Sleasman	Honors Biology	9	All year	50
Houston	Peggy Campbell	AP Environmental Science	11, 12	All year	30
		Aquatic Science	11, 12	All year	30
	Jane Compton	Pre-AP Biology	9	All year	90
	Darice Kurtzer	Chemistry	10, 11, 12	All year	150
	Jean Loedeman	Geology, Meteorology, and Oceanography	10, 11, 12	All year	95

Table 2. Learning Urban Watersheds courses and enrollments (teachers who completed the project).

A total of 386 students in these courses took the Learning Urban Watersheds pre-test at the beginning of the school year, or in the case of semester- or trimester-long courses, at the beginning of their respective course terms. They also took three “unit tests” to assess content mastery in the Texas Watch,

Texas Amphibian Watch, and Project WILD Aquatic learning activities. These tests were taken at different times during the course according to individual teachers' preference as to when they taught each set of curriculum. At the end of the course term, students took the Learning Urban Watersheds post-test, by which the project evaluator could assess performance increases as compared with the pre-test. A total of 291 students completed the post-test.

2.5: Mid-Year Intervention

In January, the Learning Urban Watersheds staff performed a mid-year check by contacting each of the project teachers by telephone to get an overall sense of how the project was going. We also specifically ask if they needed an intervention by means of a classroom visit by a Learning Urban Watersheds project staff member or an outside speaker on a specific topic from a "speakers bureau" comprising local experts associated with Texas Watch and TPWD. None of the teachers requested a classroom visit by a Learning Urban Watersheds staff member, but several teachers did request outside speakers.

2.6: Monitoring Events

The project required teachers to take their students to a nearby stream site to conduct field monitoring at least six times during the course(s) in which they were implementing Learning Urban Watersheds (Fig. 4). Each of the monitoring events could be Texas Watch, Amphibian Watch, or a combination of both. Not all teachers were able to fulfill this requirement, due to constraints such as adverse weather conditions, TAKS (Texas Assessment of Knowledge and Skills) test preparation, safety concerns at the selected site, and problems with transportation to and from the monitoring site. Most, however, were able to fulfill the requirement.



Figure 4. Students monitoring in the Dallas-Fort Worth area.

2.7: Earth Day Field Event

The Earth Day field event took place on April 21-22, 2007. Teachers were asked to select two students, each whom they would bring to Aquarena Center in San Marcos for two days of outdoor activities. The grant paid for travel expenses and one night of lodging for teachers and students who participated.

The Earth Day activities included a canoe "eco-exploration" of the aquatic habitat in and around Spring Lake (Fig. 5), a glass-bottom boat tour of Spring Lake to view the San Marcos Springs and endangered species habitat, and environmental careers panel, and student-created demonstrations of water-quality

related topics during Sunday's Aquarena Earth Day Celebration for the general public. The Earth Day Celebration was attended by approximately 300 people.



Figure 5. Earth Day canoe "eco-exploration" activity.

2.8: Evaluation

The evaluation of the Learning Urban Watersheds project was designed to measure the effectiveness of the program in increasing students' environmental literacy and sense of themselves as environmental stewards (see complete evaluator's report, Attachment F). Students were given a pre-test at the beginning and an identical post-test at the end of the courses in which they were participating in Learning Urban Watersheds (see pre/post-test questions in Appendix A of the evaluator's report). During the course term, students were also given three unit tests upon completion of each of the Texas Watch, Amphibian Watch, and Project WILD segments of the project.

The questions on the pre- and post-test were written by the project staff, and we categorized each question as a nominal, functional, or operational literacy question. These categories enabled the project evaluator to analyze students' levels of environmental literacy and changes in those levels over time. Students were also assessed for their attitudes toward the issue of water quality.

Teachers were also given pre- and post-tests at the beginning and end of the two-day training workshops to assess their knowledge of the subject matter and attitudes toward water quality issues. These surveys were virtually identical to those taken by the students, with the exception that they were also asked to rate the effectiveness of the training workshop.

The evaluator performed the following statistical tests in the data analysis: descriptive statistics, cross tabulations, analysis of variance, t-tests, paired t-tests, correlations, and chi-square tests. A total of 112 matching pre- and post-tests were identified. For the analysis, these respondents had to be divided into two groups (Study Group A and Study Group B) because one class (Study Group B) improved to such a dramatic degree as to skew the data.

The major findings of the evaluation were as follows:

- Study Group A (n=92)
 - Significant increase from pre-test scores (mean =32.4) to post-test scores (mean=38.5)
 - No significant differences were found on the pre-test scores by the variables gender, race, grade, teacher, or economic disadvantage
 - Differences were found on the post-test by the variables teacher and grade
 - “Yes” responses on pre-test to being a steward of water quality: 11 out of 92
 - “Yes” to same on the post-test: 22 out of 92
 - All 22 post-test “Yes” response students were able to list several specific examples of their stewardship actions
- Study Group B (n=22)
 - Significant increase from pre-test scores (mean=29.98) to post-test scores (mean=91.72)
 - “Yes” responses on pre-test to being a steward of water quality: 1 out of 22
 - “Yes” to same on the post-test: 22 out of 22
 - All 22 post-test “Yes” response students were able to list several specific examples of their stewardship actions.
- Overall
 - Study Group A (n=92) showed statistically significant increases in both nominal and functional environmental literacy. No significant increase in operational literacy.
 - Study Group B (n=22) showed statistically significant increases in all three levels of environmental literacy.

The following recommendations were made to improve Learning Urban Watersheds in any future iterations of the project:

- Integrate the project into multiple subject areas
 - Train teams of teachers from each school
 - Limit the project to one grade level
 - Aim for greater consistency in demographic variables and course duration
 - Include matching or control schools
- Revise testing instrument to comprise:
 - 20 nominal level questions
 - 20 functional level questions
 - 10 operational level questions
- Increase teacher training
 - Include all teachers in both workshops
 - Mid-project training/interventions
- Increase accountability and support
 - Require written support from school principal
 - Have project partners visit schools to observe
 - Plan interventions early if needed

2.9: Recognition Certificates

Upon successful completion of the Learning Urban Watersheds project, the ten participating teachers were given a framed photograph and certificate of achievement acknowledging their “mastery of the integrated teaching of environmental science and stewardship” (see sample certificate, Attachment G).

Section 3: Project Innovation

3.1: Measuring Environmental Literacy

The Learning Urban Watersheds project was designed around the concept of environmental literacy as defined by Disinger and Roth (1992) as the “capacity to perceive and interpret the relative health of environmental systems *and take appropriate action* to maintain, restore, and improve the health of those systems” [Emphasis added]. Roth (1992) identifies three levels of environmental literacy:

- *nominal* literacy, which is “the ability to recognize many of the basic terms used in communicating about the environment and to provide rough, if unsophisticated, working definitions of their meanings”
- *functional* literacy, which is “a broader knowledge and understanding of the nature and interactions between human social systems and other natural systems”
- *operational* literacy, which is “progress beyond functional literacy in both the breadth and depth of understandings and skills”

Using these definitions, the Learning Urban Watersheds project developed a means by which levels of environmental literacy can be measured. Basically, this involved the creation of evaluation instruments using questions that could be categorized as nominal, functional, or operational. Using these measures, the effectiveness of the project in increasing students’ environmental literacy could then be quantitatively assessed.

The significance Roth’s definition is that it connects environmental knowledge to environmental behavior, which addresses an age-old question in environmental education: What is the relationship between awareness and action? This project suggests that students can move along a continuum of increasing environmental literacy, all the while learning to become environmental stewards who exercise the capacity to act.

The methodology is in need of some refinement, based on what was learned as a result of this phase of the Learning Urban Watersheds project. When perfected, this new methodology for measuring environmental literacy and documenting whether or not a project is effective in increasing it will have widespread application to other environmental education programs that wish to measure their impact.

3.2: Use of Online Survey Management Technology

How do you measure the effectiveness of a project involving hundreds of participants, conducted at eight locations in two metropolitan areas, and located some 200 miles away from the project’s headquarters? With traditional paper surveys, this would be a daunting challenge. The Learning Urban Watersheds project surmounted this challenge by making use of an online survey management service called SurveyMonkey.com (Fig. 6).

Survey Title [sort]	Created [sort]	Modified [sort]	Design	Collect	Analyze [sort]	Clear	Delete
2007 Texas Watch Newsletter Survey	Mon, 10/1/07 7:14 AM	43 days ago			0		
Learning Urban Watersheds for Teachers	Tue, 5/15/07 10:24 PM	160 days ago			10		
Measures of Success Survey: Texas Watch Newsletter	Thu, 9/28/06 10:44 PM	172 days ago			14		
Learning Urban Watersheds Post-test	Thu, 12/7/06 2:18 AM	179 days ago			291		
Amphibian Watch Unit	Tue, 8/22/06 10:01 PM	179 days ago			270		
Project WILD Unit	Tue, 8/22/06 10:44 PM	179 days ago			290		
Texas Watch Unit Evaluation	Mon, 8/21/06 4:48 AM	179 days ago			256		
Learning Urban Watersheds Pre-test	Mon, 7/3/06 1:17 AM	182 days ago			386		
(Archived) Learning Urban Watersheds Pre-test Control	Fri, 9/1/06 12:43 AM	1 year ago			25		
Example Website Survey	Fri, 6/16/06 2:48 AM	1 year ago			0		

Figure 6. The Learning Urban Watersheds surveys page on SurveyMonkey.com.

Survey instruments designed by the project staff and evaluator included an overall project pre-test and post-test, and three “unit tests” for the Texas Watch, Amphibian Watch, and Project WILD Aquatic segments of the program. Through SurveyMonkey, students took all of these tests online. Data was centrally gathered and saved by the hosting website and easily downloaded for analysis by the project evaluator.

Our experience with using this relatively new technology was extremely positive and suggests that online survey management services would be a highly effective means of conducting evaluation of any project that is coordinated at a distance from project participants who are located at multiple sites. It can even be used for statewide programs and studies, including those in environmental education.

3.3: Multifaceted Curriculum

Learning Urban Watersheds utilized the curriculum and field monitoring activities of three programs: Texas Watch, Texas Nature Trackers (Amphibian Watch), and Project WILD (Aquatic). This multifaceted approach gave students a diversity of angles from which to approach the study of water resources. Not only is such an approach mutually reinforcing of the subject matter, but it also presents a wide range of possible “hooks” by which to engage students’ interest in the issue of water quality.

Moreover, the integration of field monitoring with hand-on classroom learning activities tends to engage students who have a more kinesthetic learning style (involving movement and the physical senses) as compared with traditional learning by means of books and lectures. Several teachers reported that students were enjoying the monitoring activities and being outdoors, and at least one teacher reported that the students were more interested in Learning Urban Watersheds than they were in their main curriculum.

3.4: Nature in the Urban Environment

A final noteworthy feature of the Learning Urban Watershed project is its focus on nature in the urban environment. Project participants used nearby waterways as their monitoring sites. The project cultivated a place-based understanding of water quality issues within a setting where people don't usually have a sense of their natural environment. Nature was treated as part of the urban landscape itself, not just a place to which students travel that is somehow set apart from the city (e.g., parks, nature centers, rural areas, or wilderness). Inner city students, in particular, stand to benefit from attunement to elements of nature that are found right in their own neighborhoods.

Section 4: EPA Priorities Addressed

4.1: Educational Priorities of the Environmental Education Grants Program

- 1. Capacity Building. Increasing capacity to develop and deliver coordinated environmental education programs across a state or across multiple states.*

The Learning Urban Watersheds project combined the environmental education curriculum and field monitoring activities from two statewide programs in Texas (Texas Watch and Texas Nature Trackers – Amphibian Watch) and one national program (Project WILD Aquatic). Using the three programs together gave students a multidimensional understanding of water quality issues, both in general and in their local watersheds and, we believed, reinforced the student learning experience from multiple conceptual angles (for example, water chemistry, susceptible wildlife, and habitat dynamics) and incorporating multiple learning styles (specifically, verbal, numeric, visual, audio, experiential, and kinesthetic learning). The integration of the three programs in Learning Urban Watersheds proved to be synergistic in its effects on increasing students' environmental literacy (see Section 2.7, Evaluation). Teachers reported anecdotally that their students enjoyed the Learning Urban Watersheds activities more than their regular course curriculum, and students were also integrating what they had learned in their lives outside of school, for example by identifying frogs and toads in their own neighborhoods by their distinctive calls.

The teachers who completed the project stated an intention to continue teaching Learning Urban Watersheds in their science courses in the future, beyond the term of this grant. The monitoring kits remained with the teachers for use in future classroom activities, and Texas Watch will supply replacement chemical reagents on an ongoing basis as the original reagents get used up or expire.

Geographically speaking, the Learning Urban Watersheds project was coordinated from Texas Watch headquarters in San Marcos to take place at two sites, the Dallas-Forth Worth and Houston metropolitan areas. An innovative aspect of this project was the use of online survey management technologies to collect data remotely from ten teachers and eight schools in the two project areas.

All of these capacity-building aspects of the project (multi-program learning synergy, future application of project training and materials by the teacher-participants, and intercity coordination through online technologies) are positive outcomes of the Learning Urban Watersheds project. They set an example that our individual programs as well as other environmental education programs can emulate in the future. Project staff have given, and will continue to give, conference presentations describing the

project and its outcomes as an example to others of how coordinated environmental education programs across multiple geographic sites can be developed and delivered.

2. *Education Reform. Utilizing environmental education as a catalyst to advance state or local education reform goals.*

The Learning Urban Watersheds project supported Texas state education reform goals in a number of ways. The learning activities promoted standards-based reform by cultivating mastery of a range of state secondary-level science curriculum standards contained in the Texas Essential Knowledge and Skills, or TEKS. It also reached students in socio-economically underserved populations, as documented in the participating school demographics (see Table 1). Finally, the Learning Urban Watersheds training workshops advanced the goal of improved teacher preparation in terms of both scientific knowledge and laboratory and field investigation procedures.

As consistent with findings regarding environmental education in general (see for example, Glenn 2000), the Learning Urban Watersheds project appears to have engaged students' interest and stimulated their desire to learn. This conclusion was supported by teachers' anecdotal reports to project staff. Using the local environment as an "integrating context for learning" has been found to promote improved performance on standardized tests, reduced discipline problems, increased enthusiasm for learning, and greater pride in accomplishments (Lieberman and Hoody 1998). We were unable to gather data to document changes in student performance on standardized tests, as originally intended, because those data are unavailable on an individual student basis because of privacy issues. Only aggregate data for an entire grade or an entire school are available to the public, and the project was not implemented on a whole grade or whole school basis.

3. *Community Stewardship. Designing and implementing model projects to educate the public about environmental issues in their communities through state and local government and community-based organizations, or through print, film, broadcast, or other media.*

The Learning Urban Watersheds project had an indirect impact on community stewardship. The primary objective of Learning Urban Watersheds was to improve environmental literacy and cultivate stewardship among the student participants. The project educated participating teachers and their students on the importance of protecting water resources. While it was not a specific goal of the project to educate the wider public on this environmental issue, project staff recognized that environmentally literate students will most likely grow up to become environmentally responsible public citizens.

There was one exception to this indirect impact. As part of the Earth Day field event, students were asked to create and deliver a water-quality related presentation directly to the general public attending the Earth Day Celebration held at Aquarena Center in San Marcos. Three teams of students attended the Earth Day event and gave the required presentations. One was on water purification, the second was on comparing the quality of water sampled from a variety of sources, and the third was on monitoring amphibians in the environment through call recognition. An estimated 50 people attended these presentations.

4. *Health. Educating teachers, students, parents, community leaders, or the public about human-health threats from environmental pollution, especially as it affects children, and how to minimize human exposure to preserve good health.*

The Learning Urban Watersheds project addressed the impacts of pollution on water quality and aquatic organisms, but did not specifically address impacts on human health.

5. *Teaching Skills. Providing professional development for teachers, faculty, or non-formal educators about environmental issues and content, such as sustainability, to improve environmental education skills.*

The project provided intensive professional development for teachers by means of the July 2006 two-day training workshops. They received training in field monitoring techniques for water quality and amphibians. They were also given guided practice in the use of project curriculum activities for the classroom. These training workshops resulted in increased awareness of water quality issues. Pre- and post-workshop surveys also indicated an increase in content knowledge about water quality and aquatic habitats in all except one participant.

The same surveys showed that all except one of the teachers plan to repeat the project in their science classes next year. They have all the materials and training that they need (except for replacement chemical reagents, which Texas Watch will provide upon request), and so they can continue without any further outside funding.

6. *Career Development. Educating students in formal or non-formal settings about environmental issues to encourage environmental careers.*

Career development was addressed in Learning Urban Watersheds by means of an Environmental Careers Panel discussion held during the Earth Day field event. Four career environmentalists were invited to come and speak to the participants on how they became interested in the environment and the paths by which they arrived in their current job positions. On an individual basis, some teachers included a career component when implementing the project in their classrooms. For example, one teacher requested a classroom visit by a TPWD marine biologist (through the Learning Urban Watersheds speakers bureau) because a large number of students in her class expressed interest in that particular career.

4.2: Linkage to EPA's Strategic Plan and Expected Outputs and Outcomes

1. *All proposals must support EPA Strategic Goal 5 (Compliance and Environmental Stewardship), Objective 5.2 (Improve Environmental Performance through Pollution Prevention and Innovation), and Sub-Objective 5.2.1 (Prevent pollution and promote environmental stewardship by government and the public).*

In fostering dramatic increases in participating students' self-identification as stewards of the environment, as well as their ability to identify specific stewardship behaviors, the Learning Urban Watersheds project supported EPA's Strategic Goal 5 – Compliance and Environmental Stewardship, Objective 5.2 – Improve Environmental Performance through Pollution Prevention and Innovation, and Sub-Objective 5.2.1 – Prevent pollution and promote environmental stewardship.

2. *Recipients of these grants will further EPA's strategic goals by implementing educational projects that improve behavior through non-regulatory means, raise public awareness of actions that can be taken to prevent pollution, and promote environmental stewardship.*

The project also furthered EPA's strategic goals of improving environmental behavior through non-regulatory means, raising awareness of actions to prevent water pollution, and promoting environmental stewardship.

Specific outputs that supported these environmental goals included:

- Teacher training workshops
- Classroom implementation of pre-existing curriculum materials
- Water quality and amphibian monitoring in nearby streams
- Water-quality related field events in Austin and San Marcos
- Student presentations on water quality given to a public audience
- Evaluation surveys (pre- and post-tests, three unit tests)
- Participant reflections on and photo documentation of the Earth Day event
- Video documentation (raw footage) of the Earth Day "eco-exploration" activity

We consider this project to be the initial phase of a multi-year effort to develop outreach and education strategies that improve and protect water quality. The product outputs were specifically associated with the integrative design of the program and an evaluation method by which to determine the project's effectiveness in improving environmental literacy. We have a long-term goal of producing products that are suitable for dissemination to an audience that extends well beyond the grant participants. We plan to pursue further funding in order to fine-tune the design of the program and the perfect the evaluation methodology, leading ultimately to final products that can be widely disseminated.

Specific outcomes of the project included:

- Increase in environmental stewardship
- Increase in knowledge and awareness of water quality issues
- Improved environmental literacy
- Teacher access to training on water quality and related topics
- Future continuation of the project in the individual teachers' classrooms

The most significant outcome of the Learning Urban Watersheds project was a measurable and statistically significant increase in students' levels of environmental literacy. There was also an increase in the number of students who considered themselves to be stewards of the environment. These students were able to list specific examples of their stewardship behaviors.

The ultimate benefit of the project is a long-term outcome: improved water quality. As a project that improved participants' environmental literacy, it will support and enhance future environmental protection efforts through increased citizen participation.

Section 5: Problems Encountered

5.1: Problems in Starting the Project

An initial delay in receiving the project funding precluded us from conducting the teacher workshops in summer 2005 as originally proposed. We received the award in September 2005 (instead of in the spring, as we had expected), we went ahead with “Splash Into Learning” but lost the opportunity to tie that event in to classroom implementation of the project. We received an extension and were able to launch the teacher workshops the following summer. We then revised the project plan to include a new field event, the Aquarena Earth Day Celebration that sequenced better with the classroom implementation of the project.

After the funds came through in September 2005, we spent the subsequent months working with the other project partners (Texas Nature Trackers and Project WILD) to design the teacher workshops and decide on specific activities and requirements for classroom implementation of the project.

5.2: Problems in Funding an Evaluator

Our grant proposal, as originally written, did not include any funds to hire an independent evaluator for the project, even though evaluation was intended to be a major feature of Learning Urban Watersheds. We corrected this oversight by securing \$3,000 from two programs at Texas State University–San Marcos (the Department of Geography and the River Systems Institute). An additional \$3,000 became available from the grant funds through cost savings resulting from lower than anticipated teacher turnout. These funds enabled us to hire an evaluator with the expertise to design a robust plan to evaluate the effectiveness of the project.

5.3: Problems in Teacher Recruitment and Retention

The delay in receiving the funding for the project also presented us with problems in teacher recruitment. We had originally intended to recruit teachers toward the end of the 2004-05 academic year for workshops to be held that summer. Instead, we approached teachers in the middle of the school year and got a very limited response. We overcame this problem with an intensive recruitment effort in May and June 2006. We added local nature centers to the recruitment effort, which proved to be a very effective strategy. Environmental education coordinators at nature centers in the Houston and Dallas-Fort Worth areas forwarded our recruitment flyer to teachers whom they knew to be active and interested in programs such as ours.

We did not get sufficient response from science teacher in “underperforming” schools, as we had originally hoped, and so we widened our recruitment efforts beyond the Houston, Dallas, and Fort Worth independent school districts to include school districts in the surrounding metropolitan areas.

Retention of teachers was another problem that we encountered. Of the 13 teachers who originally committed to the project, 10 completed. One teacher had to drop out due to a serious illness; another was promoted out of the classroom and into school administration; and the third found it too difficult to implement the project because the school district maintained a strictly standardized curriculum in all of its courses.

5.4: Problems Resulting from Participant Diversity

The teachers whom we recruited came from schools with a broad spectrum of demographic profiles. They also taught courses that met on a variety of schedules (semester-long, year-long, and trimester-long courses). This variability created problems in comparing evaluation data among different teachers and different courses. How, for example, could the performance of students in a semester-long course in a suburban, upper middle class school be meaningfully compared with the that of students in a year-long course in a school located in the inner city?

This variability limited the degree of scientific rigor (i.e., conclusiveness) that would be possible in the project evaluation. We accepted this limitation as an inevitable result of the problems that we had encountered in recruiting teachers for the project.

5.5: Problems in the Evaluation Procedure

The teachers ran into unforeseen logistical problems in administering the project tests and surveys to their students. Some had problems gaining access to the computer lab for their students to take the online tests in a timely manner. One was unable to administer the post-test at all, due to competing activities at the end of the school year. Others, apparently, did not recognize how crucial it was to pre- and post-testing students within the same course taught. Several teachers pre-tested their students in their fall courses and post-tested their students in their spring courses. This resulted in no matching pre- and post-tests for these groups of students, and their data was rendered invalid and had to be excluded from analysis.

By the time we became aware of this situation, it was too late to rectify it. We addressed the problem by limiting the statistical analysis of the data to those students who had matching pre- and post-tests. The number of students who took the pre-test was 386, and the number who took the post-test was 281, but we were able to confirm matching pre- and post-tests for only 112 of the respondents. That was the final number for which statistical analysis was performed.

5.6: Problems with Earth Day Event Participation

We had a disappointingly low level of attendance the Earth Day field event, held on April 21-22, 2006. Only four teachers and six students attended, as opposed to the 10 teachers and 20 students who were eligible to participate. One reason for this low attendance was competing events held that same weekend (the Texas Envirothon competition and a Science Club campout), to which two teachers were already previously committed. Another reason was that some teachers had focused so intensively on the TAKS tests, held during the week preceding Earth Day, that they were not able to expend the attention and effort needed to select students and make travel arrangements for the Earth Day event. Also, some students who had committed to participating simply canceled on the day before or the day they were supposed to travel. Their teachers were unable to make replacements on such short notice.

As a result of the low participation in the Earth Day field event, approximately \$1,500 in project funds were left unexpended. We held the event as scheduled, and those who participated gave positive responses in the post-event survey.

Section 6: Audience Reached and Breadth of Application

6.1: Audience

The audience for the Learning Urban Watersheds project was primarily high school science teachers and students in the Houston and Dallas-Fort Worth metropolitan areas. We did include one middle school science teacher who expressed strong interest in participating. (The demographic profiles for the schools that completed in project are shown in Table 1.)

A secondary audience for the project was the approximately 400 Austin-area students who participated in the "SPLASH into Learning" field event in October 2005. The April 2006 Earth Day field event in San Marcos yielded a tertiary audience, made up of members of the general public (adults and children) who participated in the student-designed and student-presented demonstrations on various aspects of water quality and pollution.

6.2: Breadth of Application

The Learning Urban Watersheds project was implemented by 10 teachers in 17 science courses in eight public schools in two Texas metropolitan areas (see Table 2). The total student enrollment in these courses (i.e., the number of students reached by the project) was 395 in the Houston area and 451 in the Dallas-Fort Worth area. The "SPLASH into Learning" field event drew nearly 400 Austin area students, and the number of general-public attendees at the Earth Day student presentations was approximately 30-40.

At least seven of the teachers who completed the project stated that they planned to continue implementing Learning Urban Watersheds in their future courses. If they do indeed follow through on their intention, this will expand the audience reached by the project by an untold number.

Section 7: Additional Beneficiaries and Future Dissemination

7.1: Additional Beneficiaries

Potentially, every school district in the state of Texas could benefit from the Learning Urban Watersheds project. The three-pronged approach combining the learning activities of Texas Watch, Amphibian Watch, and Project WILD Aquatic offers a multidimensional package of engaging science curriculum that has a strong field investigations component. Given all the attention that has been drawn to the book *The Last Child in the Woods: Saving our Children from Nature Deficit Disorder* (Louv 2005), the Learning Urban Watersheds project offers one antidote as a means for getting school children "back into the woods."

Interested teachers would need to be trained in the field monitoring activities and guided in the best uses of the curriculum. They could receive this training on an individual basis through the ongoing training activities offered by Texas Watch and the Texas Parks and Wildlife department, or they could receive training *en masse* if funding can be secured for the necessary two-day training workshops and monitoring kits.

More generally, the Learning Urban Watersheds project stands as a model for using integrated approaches to implementing multiple environmental education programs. The reinforcement of the

learning process as well as the accommodation of different learning styles provide a synergy not achievable by any single program by itself.

Also, the Learning Urban Watersheds project successfully developed a means by which environmental literacy can be measured. Other environmental education organizations could adopt a similar strategy to measure whether their programs successfully improve participants' environmental literacy and cultivate stewardship. The evaluation procedure also yielded a streamlined model for collecting and analyzing data from statewide projects with schools through the use of the Internet.

7.2: Future Dissemination

Because of the small number of valid pre- and post-tests, the Learning Urban Watersheds project cannot be considered conclusive in terms of success in increasing environmental literacy and stewardship. The evaluation results, however tentative, are nonetheless encouraging, and they have prompted us to perfect the methodology and pursue grant funding for another Learning Urban Watersheds project in a different metropolitan area in Texas. We hope to focus on all of the science classes within a single school and incorporate control groups in order to reduce confounding variables and increase the scientific validity of the project evaluation.

If successful, then we can show that Learning Urban Watersheds definitively increases students' environmental literacy. We would then have a scientific basis upon which to promote the project for potential adoption by science teachers throughout Texas.

Section 8: Environmental Outcomes

8.1: Increased Environmental Literacy

While not conclusive (at this time), the Learning Urban Watersheds project strongly suggests that students' environmental literacy can be increased through participation in the combined learning activities of Texas Watch, Amphibian Watch, and Project WILD Aquatic. The project raised students' *nominal* (conceptual) understanding of water quality issues as well as their *functional* understanding of how human activities interact with and affect natural systems. Students' operational literacy (the capacity to act in response to environmental problems) was increased in many but not all cases. Further refinement of the project design could yield stronger results at the level of operational literacy in the future.

8.2: Increased Environmental Stewardship

The project resulted in a significant increase in environmental stewardship among the students who participated. At the end of the project, the number of students who identified themselves as stewards of the environment more than doubled as compared with the beginning of the project. And, all of those students who said that they were environmental stewards were able to list several specific examples of their stewardship actions.

8.3: Improved Environmental Quality

Although the impact of the Learning Urban Watersheds project on water quality was not documented through conclusive water quality analysis, the increased environmental literacy and stewardship that the

project did document are critical components of viable strategies to protect and improve water quality. It also bodes well for the future involvement of these students (and teachers) in efforts to protect water resources. Increased environmental literacy and stewardship is expected to yield long-term results for environmental quality because resource management agencies can more effectively engage an operationally literate public in strategies designed to improve water quality.

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Louv, Richard. 2005. *The Last Child in the Woods: Saving our Children from Nature-Deficit Disorder*. Chapel Hill, N.C.: Algonquin Books.

Attachment A:

Article: 400 Students “Splash into Learning at Zilker Park in Austin

**Attachment B:
Teacher Recruitment Flyer**

Attachment C:

Article: "Learning Urban Watersheds" to Culminate at Texas State

**Attachment D:
Teacher Workshop Agenda**

**Attachment E:
Stewardship Concepts for the Learning Urban Watersheds Project**

**Attachment F:
Evaluator's Final Report**

**Attachment G:
Certificate of Achievement**